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Imaging: A Tale of Two Cities

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SIEMENS Healthineers

"With Dual Source CT imaging, the group of patients we are able to examine is broadening. This opens up options to include people who would never have been our patients before."

Stephen Trimble,
Paramedical Services Manager at Spire Healthcare, Manchester, UK

Cover:
A cinematic rendering image created on *syngo*.via shows a giant cell tumor in tendon sheath of the right ankle.
Courtesy of The Third Affiliated Hospital of Kunming Medical University, Yunnan, P. R. China.

Dear Reader,

Healthcare, like every other area of modern life, is impacted by the challenges and opportunities of an increasingly digital world and the need to balance the demand for value-based care with cost pressures.

At Siemens Healthineers, our customers' success is our main motivation and drive to continue to innovate. In this issue's cover story, we learn how Dual Source CT (DSCT) scanners are used in two very different settings in the UK – at Spire Manchester, a private hospital in the north of England, and at Great Ormond Street Hospital for Children (GOSH) in London – to make their imaging more precise and reduce radiation dose. Both facilities have expanded their clinical range and breadth of patient population significantly thanks to the speed and detail of DSCT imaging.

Healthcare providers are finding innovative ways to transform care delivery sustainably. At Herlev Hospital in Denmark, it is the human element that is managing to leverage the potential of their technology at the country's very first CT Innovation Unit. A new role has been created known as the "Flowmaster" to manage patient scanning and to make sure that their seven CT scanners are utilized optimally.

Another interesting case from Denmark shows how clever logistical and infrastructure planning can positively impact clinical outcomes. At Sydvestjysk Sygehus hospital in Esbjerg, they decided to install their new SOMATOM Force CT scanner just meters away from the emergency department so that scans can be performed quickly and without unnecessary waiting times.

Naturally, clinical outcomes and patient satisfaction are the benchmarks for successful healthcare delivery. Read about how mobile workflows enable staff at Coimbra University Hospital (CHUC) in Portugal to improve the scanning experience for their patients. Having the option to set up the CT scan via tablet means more time to spend with the patients, reassuring them and maintaining the personal touch.

In Zurich, digitalization and algorithms powered by artificial intelligence (AI) are combined with the personal touch to improve patient positioning. An advanced 3D camera integrated into the CT scanner helps the radiologist achieve the optimal position, which enables higher image quality and lower radiation doses.

In the radiology department at Great Ormond Street Hospital for Children (GOSH) and at another leading center for pediatric patients, the Astrid Lindgren Children's Hospital in Stockholm, digitalization is making the CT scan rooms a brighter place for children. During the examination process, their young patients are put at ease thanks to an entertaining audiovisual display that projects cartoons and exciting scenes onto the walls.

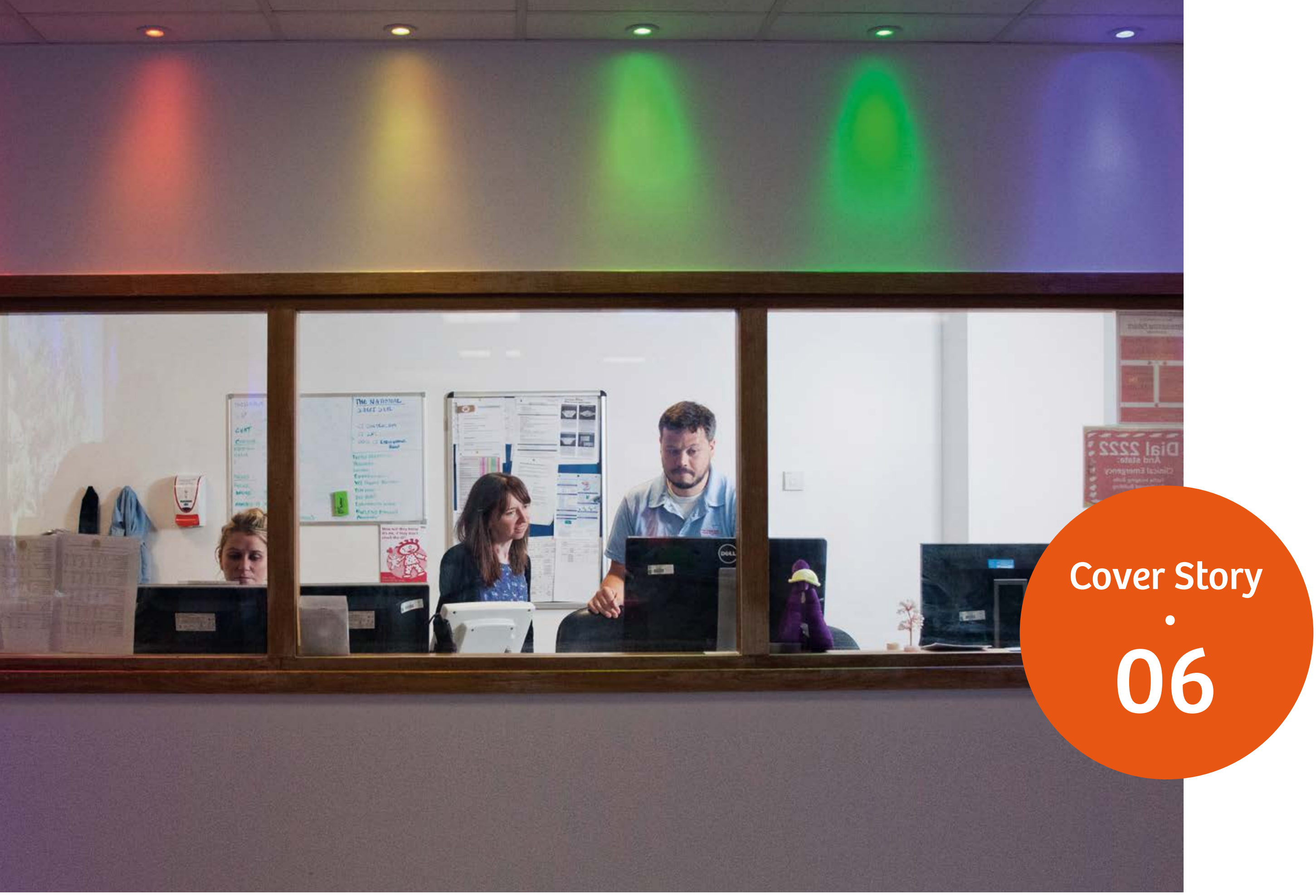
These are just some of the inspiring stories featured in this issue of SOMATOM Sessions. Find even more interesting insights, news, and clinical case reports in our magazine and let yourself be inspired by your peers. Visit our online magazine platform, CT News & Stories (siemens-healthineers.com/ct-news), for further valuable input.

Enjoy reading our latest issue!

C. Bernhardt

Christiane Bernhardt,
Vice President CT Marketing and Sales

The statements by Siemens Healthineers' customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other customers will achieve the same results.



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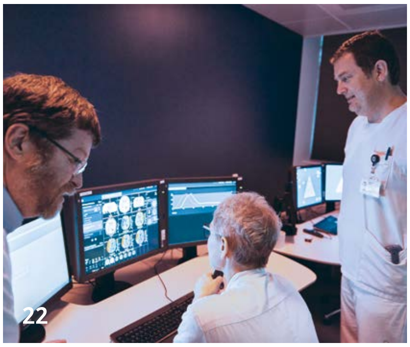

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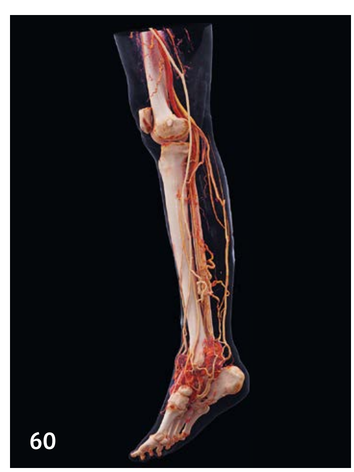


Imaging: A Tale of Two Cities

Healthcare in Britain is divided between the public and the private sector, just as there is rivalry between the North and the South of the country. However, when we looked at the imaging departments of two leading hospitals from either side of these divides, we found more similarities than differences.

Text: Dan Whitaker | Photos: Andrea Artz

GOSH's former chief radiographer Anna Guy with technicians Judith Humphries and Paul Xavier in the DSCT Control Room at GOSH in London.

In the North…

Didsbury was once a medieval village by the bank of the River Mersey. Now its redbrick Victorian villas offer comfortable residences for those working in Manchester – a city famous for its dominant football teams, swaggering pop stars, and a commercial drive that has led to the UK government calling it 'the Northern Powerhouse'.

Also here is Spire Manchester, the flagship facility of Britain's leading private hospital network, purpose-built only last year. Every element of its radiology and physiotherapy department was planned by a local man, Stephen Trimble. Signs of Trimble's local roots include a signed photo of Manchester United FC manager, José Mourinho, on his office wall. He can also remember when his own father used to play football in the fields where the hospital now stands, some years before Stephen set off to obtain his MSc in Advanced Practice (Clinical Radiographic Reporting) from the respected local University of Salford.

Lower doses the main thing

Now, surveying the busily humming department with deserved pride, Stephen's smile lights up most when showing visitors their SOMATOM Drive, the first Dual Source CT (DSCT) scanner of its type in the country, and still the only one in the region. "The main thing with CT imaging is the radiation dose," he explains, "and the minimal dose from the dual source scanner has meant three to four times as many referrals coming through compared to when we had our single source 16-slice machine before."

A coronal MPR and a VRT images show a whole body native scan for a 7-year-old girl who comes for an annual check on her rare genetic vascular calcification. A scan range of 1.355 mm was acquired in 14.7 s using tube voltage of 80 kV and radiation dose of 0.57 mGy.

Stephen Trimble at SPIRE's DSCT, which has increased referrals to the department by three to four times.

"Where once a CT scan would be followed up by an X-ray, multiple DSCT images make this unnecessary, and consultants and radiologists appreciate this," he says, meaning both the private referrals and the 30 percent of his patients who are referred across from the public sector National Health Service (NHS) under contract. Stephen and his staff also enjoy the machine's speed, another contributory factor to maximum daily throughput rising. He confirms that the resulting increase in revenue has easily outweighed initial purchase and higher service costs.

Expanding service to more patients

The new scanner is increasing Spire's range in two ways. Therapeutically, it means more musculoskeletal and neurological cases in addition to the cardiology cases that have been the mainstay. And the sources of patients are also broadening. Stephen mentions a seven-year-old girl that a local NHS hospital now sends to him for an annual check on her rare genetic vascular calcification. Another middle-aged man flies in from the Isle of Man for a cardiac scan and is able to fly back the same day – avoiding a longer, invasive cath lab procedure that he used to endure. Neither would have been patients before the DSCT scanner arrived.

...and in the South

While the young girl that Spire is helping is a rarity there, children are everything at another hospital some three hundred kilometers to the south. London's Great Ormond Street Hospital (GOSH) is the country's leading pediatric institution, itself a flagship of the NHS and possibly the health facility closest to the heart of the British public. GOSH is over 160 years old, a hospital Charles Dickens would have known, and with a tight city center footprint, radiology here takes place in an underground warren of corridors where the weight of the equipment does not challenge the more fragile floors higher up in the building.

If London has to endure the ignominy of losing in football to the smaller city to its north, it retains

Anna Guy, former chief radiographer at London’s GOSH has focused on treating children throughout her career.

confidence in its stronger international links. GOSH’s former chief radiographer, Anna Guy, is about to follow one of these, after 13 years of experience working across all imaging modalities in the NHS, to move to a post in Australia. Days before her departure, she sits and explains some of the differences when your patients are only a few years old: “For a start, any child under five will be what we call ‘non-compliant’, probably screaming and struggling – all perfectly understandable in an unknown situation with anxious parents, and all of the adults retreating behind a screen.”

Designed for imaging children

Several features of GOSH’s SOMATOM Force help especially with children. Its more precise images are no longer blurred by the inevitable crying. But those same unhappy convulsions are themselves lessened, due to soothing colored lights, which GOSH supplements with fish-tank wall, ceiling, and floor images, all of which react interactively to movement. “It’s a great talking point, and when the kids see they can change it by waving, then they feel a vital bit of control over the process,” Anna says. One of her team smilingly holds up one further ally in the battle for children’s equilibrium – a stuffed toy turtle called Charlie.

The faster table speed is another advantage, especially when compared to the half hour combined with anesthetic that an MRI scan might require. Anna recounts that her team “cheered” the first time they saw how rapidly their new CT scanner moved. This is complemented by modulation, which can differentiate automatically between a 3 kg baby and a 9 kg one. Anna admits: “I was dubious about this ability, but it can and that can be very helpful”.

Better clarity for smaller patients

Just like at Spire, at GOSH, too, the DSCT scanner’s finer imaging has broadened the case mix, as slender blood vessels become more visible, even on neonates weighing less than a kilo, for example. The improved imaging is adding more lung pathologies and oncology cases to a patient roster that still remains more than half chest cases.

Anna tested image clarity herself by conducting a study of 600 chest patients, all weighing under 15 kg, half were scanned in 2016 with the new dual source device, and the other half in 2015 with the previous single source scanner. Without knowing the origin of each scan, two radiologists rated the DSCT scans as around one point clearer on the accepted five-point clarity scale – equivalent to the difference between a 'poor/fair' and a 'good' image. This powerful evidence is now likely to be published.

Lower doses for little bodies

The avoidance of anesthetic can be important. Anna recalls one four-year old with severe pulmonary hypertension who needed a CT scan to plan surgery. "With this condition, children's risk of death from anesthetic rises significantly, so it is to be avoided whenever possible. Due to the SOMATOM Force's high-speed image acquisition, the scan was completed without the need for anesthetic, diagnosis was made, and surgery was successfully planned and carried out. The team were very happy with the resultant images and the CT scan was integral in making decisions about this child."

But overall what matters most at GOSH is the DSCT scanner's reduced radiation dose, often around half that of the previous scanner. "Children inherently have a longer lifetime risk from any radiation," Anna points out. This issue is an important one, not only for GOSH's 2,500 scans per year, with pediatric healthcare demand rising in many countries as fast as that from the elderly.

Despite all of the additional challenges, Anna Guy finds working with children as patients more rewarding. "They are more honest with their emotions, which doesn't make things easy, but when a child leaves the scanner room calmed and with a smile on their face, that is worth a lot."

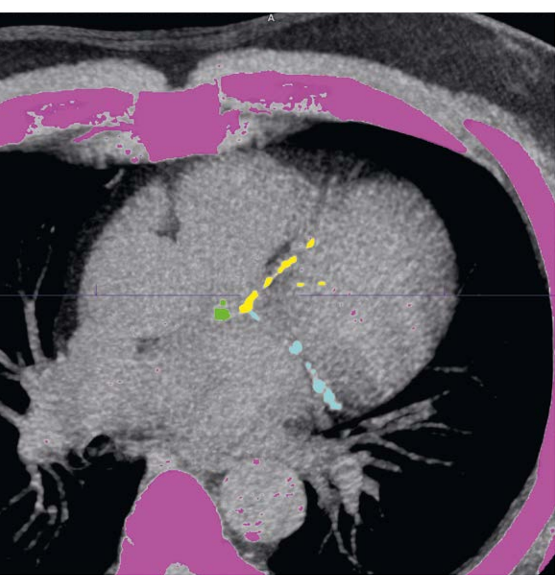
Dan Whitaker is an independent journalist based in London.

The statements by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.

The Somotom Force at GOSH utilizes interactive lighting to keep it's smaller patients calm during scans.

Time to Rethink the Calcium Scoring Workflow

The relationship between calcium deposition and the development of coronary artery diseases (CAD) has been well known for decades. As early as 1990, Arthur Agatston and his colleagues introduced the first practically applicable procedure to quantify calcium in coronary arteries – but the acquisition methods for this quantification have not evolved much since then. This is set to change.



syngo.CT CaScoring provides a quantitative measure of coronary calcium by means of Agatston score or calcium mass score.

CACS history at a glance

Agatston and his colleagues considered any structure with a density of greater than 130 Hounsfield units (HUs) and an area of at least 1 mm² encountered in the coronary arteries to represent calcified plaque.[1]

To be able to produce pictures in sufficient quality, Agatston set his Electron Beam CT (EBCT) to 130 kV. His procedure became standard for Coronary Artery Calcium Scoring (CACS) – also widely known as the Agatston Score – and so did his tube settings.

Up until now, reliable CACS results meant limiting image acquisition to 130 kV or, thanks to the improved spatial and temporal resolution of multidetector CTs (MDCT), to 120 kV. That lead to a significant lack of flexibility. "Nowadays, calcium score at 120 kV can result in a radiation dose comparable to some coronary CTA protocols," says Hugo Marques, MD, radiologist at the Hospital da Luz in Lisbon, Portugal. Modern imaging equipment, however, has advanced considerably since then, particularly the introduction of low kV for image acquisition and the associated benefits of radiation dose reduction.[2] This raises the question: Is there a way to get CACS results comprising these benefits that neither over- nor underestimate the Agatston Score but are not subject to the usual "historic" restrictions? Luckily, the future is just around the corner.

Tackling restrictions with reconstruction

Currently, only Siemens Healthineers provides a special reconstruction kernel along with their proven low kV capabilities and the unique 10 kV step selection. With this powerful combination, the traditional restriction to 120 kV is tackled and kV settings can be chosen freely allowing for Agatston-equivalent calcium scoring with any kV. In CAD research – especially in trending topics like calcium subtraction – but also in everyday clinical use, this innovative approach has huge potential to become a game changer:

"Having the possibility of doing calcium score at lower kVs not only could result in big radiation dose saving, but would also allow for similar kV settings in both calcium score and cCTA acquisitions."

Hugo Marques, MD

Following the same people-centered path as many other clinical fields, imaging technology will be matched to patients' needs, rather than the other way around.

This approach also offers great benefits for patients compared to conventional CACS: Most importantly, it introduces the advantages of low kV scanning but could also allow the re-use of scans that were initially acquired for a different purpose. If there are existing images – for example native thorax acquisitions – it may be possible to use these directly for the quantitative measure of coronary calcium. Reducing the number of scans necessary and lowering the voltage whenever possible opens up the potential to significantly save radiation exposure to patients. "Dose optimization for calcium score could have a big population impact since CACS as an advanced cardiovascular risk assessment exam is gaining acceptance especially for intermediate risk asymptomatic individuals," Marques adds.

Ready to become an innovation leader?

Low-kV scanning and Tin Filter technology have proven their value in other domains of cardiovascular imaging – and a few visionary pioneers have already realized how they can benefit from this new approach to calcium scoring in their daily routine. Now the time is right to join them.

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[2] Bischoff B, et al. JACC Cardiovasc Imaging. 2009 Aug;2(8):940-6.

Agatston Score values derived from measurements of the calcium scoring reference phantom based on the uncorrected Qr36f (top) and the new, corrected Sa36f reconstruction (bottom). Sn100kV: 100 kV setting combined with Tin Filter

Hugo Marques, MD, is a radiologist – specializing in cardiovascular imaging and intervention – at the Hospital da Luz Lisboa and the Hospital de Santa Marta Lisboa. About 2,600 cardiac scans are conducted there annually which usually are preceded by calcium scoring.

Ronald Booij, Coordinator of Research and Innovation at the CT Unit at Erasmus MC in Rotterdam.

3D Measurement Camera and the Personal Approach in Radiology

Two European hospitals are combining the human approach and radiology technology in symbiosis. Their personal touch together with high-end 3D measurement cameras[1] helps provide better image quality and an optimized radiation dose.

Text: Erika Claessens | Photos: Philip Frowein

The Swiss University Hospital Zurich (USZ) and the Dutch academic hospital Erasmus MC in Rotterdam are leading European hospitals that provide fundamental medical care and cutting-edge medicine for national and international patients. Erasmus MC ranks as the top European institution in clinical medicine according to the *Times Higher Education* rankings. It is the largest and one of the most authoritative scientific university medical centers in Europe. USZ treats around 542,000 patients in 43 specialist departments and institutes each year. It is one of the largest hospitals in Switzerland, and the percentage of patients with complex diseases is particularly high there.

Ronald Booij is Coordinator of Research and Innovation at the CT Unit at Erasmus MC, which is situated in a brand-new hospital building in Rotterdam. The transparent architecture, made up of various layers, appears inviting. "With its fitting design and its 'healing environment', it claims to reduce the time a patient has to spend in hospital, while at the same time providing an enhanced quality of care," says Booij.

"With 3D camera technology, the patient can be accurately positioned to within a few millimeters."

Natalia Saltybaeva, Medical Physicist and Scientific Researcher, University Hospital Zurich

Revolution in radiology

"The clear structure of the building is beneficial to stress reduction and patient well-being," he says. "During the last few years of my 20-year career here, I have witnessed a rapid evolution in patient care and technology. As Innovation Coordinator and PhD candidate in Radiology and Research, I have always been driven by innovative solutions for healthcare. "I have always wanted to know how these solutions really perform in a clinical context," comments Booij. "I am convinced that the advent of computed tomography has revolutionized radiology."

3D camera with great potential

"We have six scanners in our radiology department. Two are already equipped with a 3D measurement camera," says Ronald Booij. According to Booij, the increasing awareness of the risks associated with radiation exposure has always been one of the department's main concerns. "We can only enhance the patient experience and care with a clear operating protocol and accurate patient positioning. And the 3D camera has great potential when it comes to positioning."

"In the past, this patient positioning technology simply did not exist," states Natalia Saltybaeva. As a medical physicist and scientific researcher at USZ, she says radiation dose optimization algorithms used to be a kind of black box. "It kept its secrets," she says. "But nowadays we can benefit from technologies for very precise patient positioning. This allows us to avoid mistakes. For example, when our technicians position the patient manually, they are typically about three centimeters off-center. With 3D camera technology, the patient can be accurately positioned to within a few millimeters using infrared images and 3D data in combination with deep learning algorithms."

Significant improvement in patient centering

Natalia Saltybaeva is the co-author of a study performed in Zurich that evaluated the accuracy of a 3D camera algorithm for automatic and

[1] 3D measuring cameras commercial name is FAST 3D Camera

"The 3D camera is my personal backup. It feels like we're working together."

Ronald Booij, Coordinator of Research and Innovation, Erasmus MC, Rotterdam

individualized patient positioning based on body surface detection.[1] Together with Professor Hatem Alkadhi, MD, Head of the Institute of Diagnostic and Interventional Radiology at USZ, she compared the results of the 3D camera workflow with manual positioning carried out by radiology technologists in chest and abdomen CT examinations.

The study included the data of 120 patients undergoing consecutive CT examinations with and without the help of a 3D camera. The team found a significant improvement in patient centering (offset 5 ± 3 mm) when using the automatic positioning algorithm with the 3D camera compared with manual positioning (offset 19 ± 10 mm) performed by technologists ($P < 0.005$). Automatic patient positioning based on the 3D camera reduced the average offset in vertical table position from 19 mm to 7 mm for chest and from 18 mm to 4 mm for abdominal CT scans. The absolute maximal offset was 39 mm and 43 mm for chest and abdominal CT scans, respectively, when patients were positioned manually, whereas with automatic positioning using the 3D camera the offset never exceeded 15 mm.

Determining the optimal position

In the radiology department in Rotterdam, the 3D camera has been used in connection with the SOMATOM Drive and the SOMATOM Edge Plus for more than a year. "At first, I was not convinced about the added value of the 3D camera," says Ronald Booij. "In fact, I was rather skeptical. We are well-trained, professional radiographers and we prefer to position the patient ourselves." But he does admit that it is sometimes difficult to interpret the optimal table position for the body part to be examined. "Every patient is unique, from their body shape to the clothing they are wearing. And the isocentering itself, which is done on the spot by the radiographer with the aid of a laser beam, is not always easy to accomplish." He points out that the curve in the middle of the scanner gantry is also one of the reasons why it can be more difficult for a radiographer to accurately estimate patient positioning and define the right scan protocol: "We tend to position the patient lower than needed, which can lead to serious deviations from the ideal isocentering."

"Believe it or not," says Professor Alkadhi, "positioning is indeed an issue. We know from a study by J. Li and his team, which was published eleven years ago already, that approximately 95 percent of the patients undergoing a CT scan were not positioned accurately in the gantry isocenter.[2] So it is obviously a big issue. It is not a rare occurrence."

Alkhadi also states that from a dose optimization study by Schmidt and his team they learned that the dose from localization radiology may contribute significantly to the total effective dose of low-dose CT examinations such as lung cancer screenings.[3] Optimal settings can reduce the localizer radiography dose substantially but adaptations have to consider scanner characteristics, detector technology, and patient size.

Image quality and radiation dose

Booij, Alkadhi, and Saltybaeva are all convinced that there is still room for improvement and that the 3D camera can be of great help for the accuracy of patient positioning. Says Ronald Booij: "You will never hear me say that we no longer need radiographers. On the contrary, I believe we need a symbiosis. The human factor has to go hand-in-hand with the technology to offer more accurate patient positioning, resulting in an opti-

In Zurich, the SOMATOM Edge Plus together with its 3D camera allows for improved patient positioning in comparison to manual positioning as study results show.

mized result. At the end of the day, a better patient outcome is always our goal. Optimization of image quality and radiation dose leads to a better diagnosis and consequently to better healthcare. The 3D camera is my personal backup. It feels like we are working together. One cannot work without the other." In the upcoming years, artificial intelligence (AI) is likely to fundamentally transform diagnostic imaging. But AI will not by any means replace radiologists and radiographers – rather it will provide them with tools to meet the rising demand for diagnostic imaging and actively shape the transformation of radiology into a data-driven research discipline. ●

Erika Claessens works as an independent journalist from Antwerp, Belgium.

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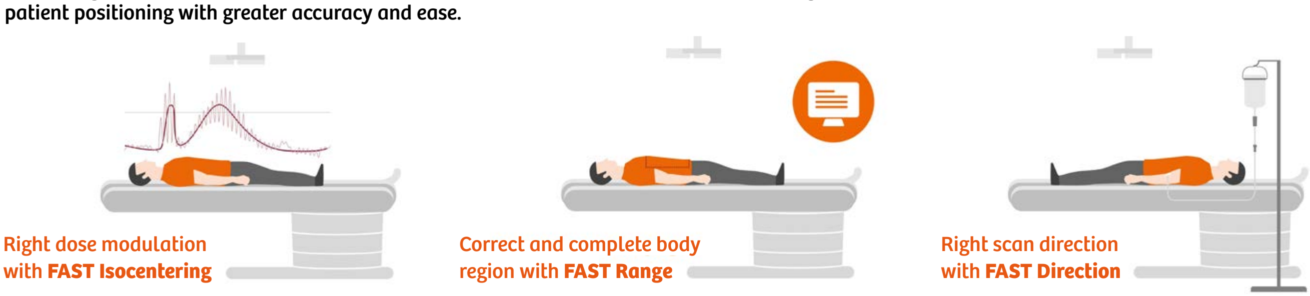
More research results in a currently published study from Ronald Boij et al.:
Journal: *European Radiology*
DOI: 10.1007/s00330-018-5745-z
Title: Accuracy of automated patient positioning in CT using a 3D camera for body contour detection

FAST Integrated Workflow

FAST Integrated Workflow with FAST 3D Camera is connected with FAST Features, allowing automated patient positioning with greater accuracy and ease.



Making CT Child Friendly in London and Stockholm

Great Ormond Street Hospital for Children (GOSH) in London and the Astrid Lindgren Children's Hospital in Stockholm have developed new strategies for dealing with the most difficult diagnostic challenges – small children, who are scared or anxious and cannot just be told to lie still during a scan.

Text: Linda Brookes and Nils Lindstrand | Photos: Andrea Artz and Lasse Burell

The need for a calm environment

Every year, over 250,000 children from all over the UK and overseas come to GOSH in London for its wide range of pediatric health services and high-quality facilities. In the radiology department, which performs around 57,500 exams per year, the priority is to get the right technology, says Catherine Owens, MD, consultant radiologist at GOSH. But putting patients and their families at ease by creating an age-appropriate, child-friendly environment in the department is not regarded as just "frills", she stresses.

"By minimizing patient trauma and getting diagnostic images in small children who are often not very cooperative, we are able to maximize image quality and output," Owens explains. "By creating a welcoming environment, we have also increased the numbers of patients scanned and the numbers of patients having scans without sedation or anesthesia." A "win-win" situation is how Owens describes it.

Most of the patients who come to GOSH will return for scans several times over many years, so it is very important to give them a positive experience with their first scan which does not leave them traumatized and refusing to have another exam on their next visit. Owens emphasizes, "It is cumulative exposure to both radiation and to personalities and structures in the department." She and her colleagues create as positive an experience as possible by preparing patients and their parents for their visit beforehand, by training staff to interact with children,

At Astrid Lindgren Children's hospital in Stockholm, an audiovisual display helps to make kids feel comfortable before a scan.

through special decorations in the exam and waiting rooms, and by use of distraction techniques.

Distraction works

Having staff at GOSH who are used to dealing with children and are able to put them at ease, particularly when using the scanner, is key. Owens says, "There are popular staff members whom the children may only see once a year, but it has a huge impact on them to see friendly faces – it makes them feel happy and relaxed."

The GOSH radiology department also works with hospital play-specialists, who sit with patients and help them understand the process ahead of time. Children can touch the scanner and the controls, and operate them without exposure. "This is especially valuable for more nervous children, such as those with learning disabilities, autism, or challenging behaviors," Owens notes.

Because CT is a very fast examination (only 2–3 seconds), the main part of making the child feel comfortable is getting them into the exam room. For a child having a CT scan at GOSH, the fun starts in the waiting room, where there is an interactive projection on the floor with motion tracking, so that when anyone walks on it, bubbles appear around their feet. "It is incredibly pretty and a very clever way of introducing children to the room," Owens notes.

The exam room itself is not so large that it is intimidating, nor so tiny that it looks like it is all one big machine, Owens explains. There are a lot of different colored lights around the room,

Having a welcoming environment in the scanning area created a "win-win" situation for patients and the medical team at GOSH.

including lights in the ceiling at the periphery that the child can change using an interactive pad. There is wall art, including a projection panel of an underwater scene showing coral and rocks, with fish that move, and a ceiling projection of swimming turtles above the scanner.

To get children to remain completely still in the scanner, several different immobilization and/or sedation techniques are available. Children aged under 2 years are wrapped in a blue padded blanket to make them feel comfortable. There are also plenty of large cuddly toys that can be placed on the scanner to distract the child during the process.

At GOSH, parents accompanying the children are very important in distracting the child. The hospital staff will conduct discussions with them in advance of the visit about what to expect and what they can do when they arrive. They can bring in an iPad or other tablet or their own DVDs to play cartoons for the child during the scan ('Peppa Pig' is popular!). The parent can hold the tablet or it can rest in a specially constructed frame that the child can hold.

Many mothers bring cellphones preloaded with music and sing along with their children. Owens notes that GOSH patients come from a wide range of multicultural backgrounds and a number have traveled from overseas. On-site translators are available, but often they are not needed, as many of the children are happy just listening to music or watching cartoons without sound, she says.

"By minimizing patient trauma and getting diagnostic images in small children who are often not very cooperative, we are able to maximize image quality and output."

Catherine Owens, MD
Great Ormond Street Hospital for Children, London

Owens and her colleagues have shared their experience with other hospitals worldwide, including representatives from the Astrid Lindgren Children's Hospital, which set up its own pediatric CT unit. The new scanning room design worked, and not only for the children.

Projections, cartoons, and scanning

The patients at the scanning center at Astrid Lindgren Children's Hospital are often very small, some of them just babies. They move, they refuse to lie down on the scanning table, or simply won't go near the impressive, but somewhat scary, piece of technology.

"When we moved Astrid Lindgren Children's Hospital to the new hospital complex where we are today, we realized we wanted to do something drastic to convert the scanning room into a friendly environment for children," says Lena Gordon Murkes, MD. "It was clear that the latest in scanning technology gave us a chance to get good images even with children as patients, but we still needed to get them to cooperate and to be calm for a few minutes".

Gordon Murkes knew of a company in Sweden that is developing audiovisual technology for commercial and educational use. "I phoned them up, and we started collaborating to create a scanning room that would invite and calm children and parents instead of scaring them," she explains. Cartoons, light effects, and video films are projected onto walls or complex backgrounds, using very powerful projectors.

By combining a bit of modern magic with committed professionals, the challenge has been turned into a major success. The rest of the room is dark, and the gantry is covered with images of stars, rainforest backgrounds, or simply dreamlike flickering lights. For small children, popular cartoons are screened on the ceiling. And it worked – it really worked.

At the Astrid Lindgren Children's Hospital, Gordon Murkes says, "We had one boy about ten years old who was autistic. He got very anxious when he was about to lie down on the scanning table, and got quite aggressive in his agitated

"The audiovisual display gives our little patients something beside the health issues to talk about. This provided a much more calm, positive situation."

Lena Gordon Murkes, MD
Astrid Lindgren Children's Hospital, Stockholm

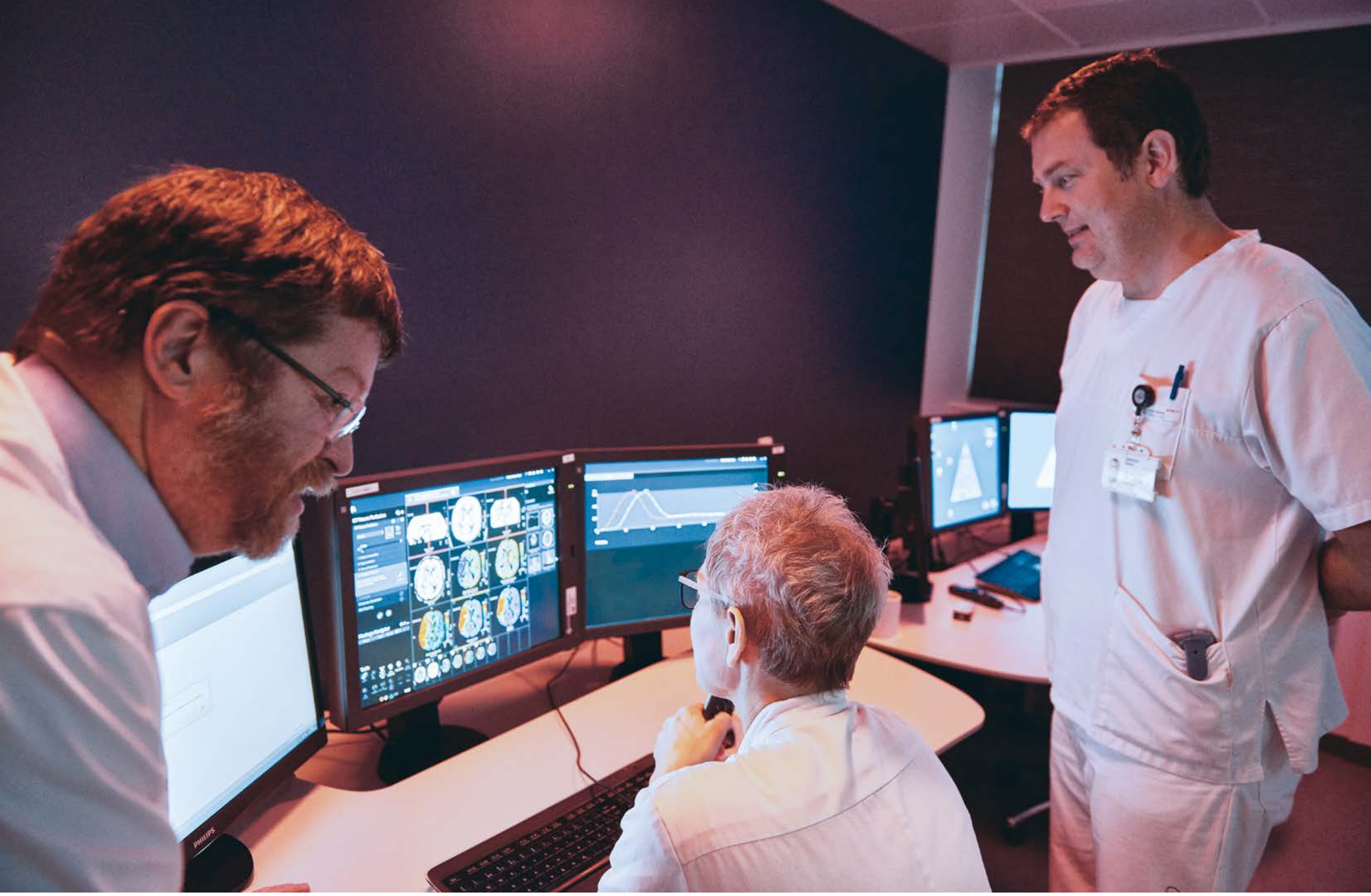
state. But when we showed the popular children's cartoon 'Babblarna', originally created for children with reading or communication disabilities, this young man became quite calm, and totally focused on the story played out in the cartoon."

Gordon Murkes says, smilingly, that the old challenge of getting the children to lie still during the scanning procedure has been replaced by the problem of making them leave. "If we show them one episode of a popular cartoon, they want to watch all the episodes before they have to go home."

"We also saw the positive effect it had on the parents," says Lena Gordon Murkes. "They came in, obviously very anxious about what the scan would show, and nervous about the scanning procedure as well. The audiovisual display gives them another focus, and something beside the health issues to talk about. This provided a much more calm, positive situation overall." ●

Linda Brookes is a freelance medical writer and editor who divides her time between London and New York, working for a variety of clients in the healthcare and pharmaceutical fields.

Nils Lindstrand is an independent business and technology writer based in Stockholm, Sweden.



Cooperation is very much the key to success for the new emergency department: Christian Christiansen, MD, Lene Guldberg Hansen, MD, and radiographer Martin Weber Kusk (from left to right) at Sydvestjysk Sygehus hospital discuss a case.

Cooperation and Technology – the Keys to a Danish Hospital's Success

A Danish hospital invested in the latest technology for its emergency department. This led to a complete reorganization – and a journey to the top of the country's hospital ratings.

Text: Nils Lindstrand | Photos: Claus Sjodin

Several years ago, Sydvestjysk Sygehus hospital in Esbjerg, Denmark, decided to invest in new equipment for its emergency department (ED). As part of this process, all the hospital's medical staff met to discuss which new technologies would benefit their patients most and how their investment could best improve hospital efficiency. The solution they came up with was a completely new concept, based on state-of-the-art CT scanning technology and the optimal way of using it.

"We are very proud today of how we have managed to change the logistics of this hospital and the way doctors work together," says Christian Christiansen, MD, head of the ED.

Based on these discussions, the hospital came to the conclusion that the only way it could afford to buy the very best equipment was to improve cooperation between staff. "It became clear that there was no way the hospital could find enough money to buy everything that every specialist or department would like to have," says Christiansen. "We realized that we had to figure out how to change the way we worked from a wider perspective."

The staff concluded that the key was to provide emergency patients with the correct care from the very start. Instead of sending patients to a ward, or even back home with a letter asking them to return the following week, the hospital saw an opportunity to do things properly from the word go. Christiansen continues: "We realized that if we had the option of scanning every patient coming into the ED, we could give them the correct treatment in the right place and by the right specialist." This approach would also enable staff to decide at a very early stage whether a patient could completely avoid a stay in hospital and, in fact, be discharged with the good news that their medical concern was a false alarm. To facilitate this, the new scanner would need to be able to work with every patient coming into the ED – irrespective of the clinical question, patient age, or pre-existing illnesses such as renal insufficiency or cardiac instability. Ultimately, this way of organizing the ED should result in a very efficient hospital and higher quality patient care.

To test whether this idea could be implemented, the staff created a model with a CT scanner and peripheral technical equipment in the basement of the hospital, and used it to perform simulations. The results were encouraging and the process of reorganizing and installing the new equipment was continued.

Minimal patient movement and smooth cooperation

Today, if there is an indication, every emergency patient at the hospital can receive a CT scan just a few meters from where they are taken out of the ambulance. A team of medical staff decides on the most appropriate treatment, and the patient is either discharged or taken to a specialist ED ward nearby to receive that treatment. The layout of the ED is designed to minimize the distance the doctors have to travel to the patient, and to facilitate cooperation between staff. Indeed, cooperation is very much the key to success for the new ED.

"The principle is to take the doctors and equipment to the patient instead of moving the patient around," says senior surgeon Lene Guldberg Hansen, MD. "Moving patients around always increases the risk of something going wrong, so a better alternative is to move the doctors."

The staff concluded that the key was to provide emergency patients with the correct care from the very start.

Christian Christiansen, MD, uses management software to organize which patients should be discharged and which should go to a nearby ED treatment ward.

"This part of the hospital is normally quite calm, despite the obvious pressure that work in an emergency department brings. Everything is very well organized and standardized, and everyone knows where everything is."

Christian Christiansen, MD, head of ED

Hansen points out that this new approach requires a change in doctors' attitudes to some extent. It was not necessarily something that came naturally to all doctors from day one. "This is not my patient" or "I'm busy on my own ward" are some of the reactions that had to be dealt with. Overcoming this slight resistance was definitely a success story for the hospital – and one of the reasons why Christiansen says he is particularly proud of how the doctors work together today.

Today, 70 percent of all emergency patients are treated and discharged from Esbjerg hospital within 48 hours.

Patients first

"We introduced the slogan 'Patienten först' (patients first) to provide a foundation for the new approach to our work," he says. "You may say that a slogan like this is oversimplified and superficial, but we have made it work in everyday situations. The reason it is successful is that we use the phrase all the time to make decisions about patients in every situation, every day."

The question "What would be best for this patient right now?" may result in a call to a doctor at the other end of the hospital, asking him or her to come and help. "Today, all the doctors at our hospital are integrated into the ED's work," says Christiansen. "And, as I said earlier, we are very happy that we made this work."

The results have been very clear. In national Danish hospital reports, Sydvestjysk Sygehus has gone from “somewhere toward the bottom” to third place in terms of patient satisfaction.

Today, 70 percent of all emergency patients are treated and discharged within 48 hours. Before the new scanner and workflow, patients were usually transferred to a ward and eventually examined to establish what kind of treatment they needed. Now, they no longer have the unnecessary wait for examinations or treatment.

Radiologist Martin Weber Kusk provides an example: “Instead of giving a patient a preliminary examination and then a doctor’s appointment two weeks later, we can establish what needs to be done very quickly and, in many cases, implement this within a day or two. This means higher hospital efficiency – and two weeks less worry for the patient.”

Efficiency and safety boost patient satisfaction

The hospital’s decision to invest in a high-quality and high-capacity CT scanner like SOMATOM Force has thus paid off in a multitude of ways. Nevertheless, Guldberg Hansen also mentions the fact that the Force requires a lot of knowledge and skills to achieve a good result: “This scanner uses advanced technology and provides incredible amounts of information. Compared to older technology and routines, it needs staff who are open to change and can adapt to new workflows and technology to draw optimal conclusions from the information delivered by a CT scan. This gives hospitals the opportunity to become extremely efficient, resulting in safe and satisfied patients.” The hospital’s SOMATOM Force allows staff to perform, for example, cardiac examinations of virtually any heart rate due to the ultra-fast temporal resolution of 66 ms, or free-breathing examinations of the lung due to the high pitch mode. In addition to this, dose is always taken into consideration: The SOMATOM Force keeps this to a minimum with low-kV imaging and two powerful 120 kW generators.

Sydvestjysk Sygehus is a medium-sized regional hospital in Denmark. The ED has a daily volume of about 40 to 50 patients, all of whom can be scanned just seconds after entering the department. The maximum number of patients so far has been 200 in one day. Every patient spends about five minutes in the scanner room. “This part of the hospital is in fact normally quite calm, despite the obvious pressure that work in an emergency department brings. Everything is very well organized and standardized, and everyone knows where everything is and what to do in any given situation,” says Christiansen.

The SOMATOM Force was installed in April 2015. “This was a happy day for the hospital,” he says, smiling. In addition to the success for the ED in terms of patient satisfaction and general efficiency, the scanner is also used for non-emergency patients when the ED is not using the equipment to full capacity. The use of the scanner is also constantly being developed in terms of the type of patients and medical conditions that are analyzed. “We use a continuous improvement strategy,” says Christiansen. Innovations that optimize clinical pathways with the use of the scanner are a key part of this work. ●

Nils Lindstrand has been working as a science writer and journalist for more than 30 years. He is based in Stockholm.

Martin Weber Kusk, Lene Guldberg Hansen, MD, Christian Christiansen, MD (from left to right): The SOMATOM Force, installed in April 2015, has made the hospital extremely efficient, which results in safe and satisfied patients.

The statements by Siemens Healthineers customers described herein are based on results that were achieved in the customer’s unique setting. Since there is no “typical” hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.

Patients First

Povisa Hospital, a private facility in Vigo, Spain, focusses first and foremost on one thing: patient-friendly care. This is why the clinic works with the latest in CT technology, allowing it to provide the best in healthcare, and to work quickly and as close to their patients as never before.

Text: Manuel Meyer | Photos: Luis Díaz Díaz

José Antonio Vargara uses a tablet, allowing him to stay with his patients longer.

The radiology department at Povisa Hospital in Vigo, on the Galician Atlantic coast in Spain, is bustling with activity. What is usually a medium-sized private facility with 450 beds regularly takes on numerous national health insurance patients because the two public hospitals can't provide care for the approximately 600,000 people who live in Vigo and the surrounding fjords in the extreme northwest of Spain.

Today, the private hospital is responsible for about 139,000 residents, which means a lot of work for radiology: According to chief radiologist Francisco Tardáguila, up to 20,000 CT scans are carried out each year by his 15-member team. And on this particular morning, around ten patients are already waiting in the corridor of the department for their CT scan.

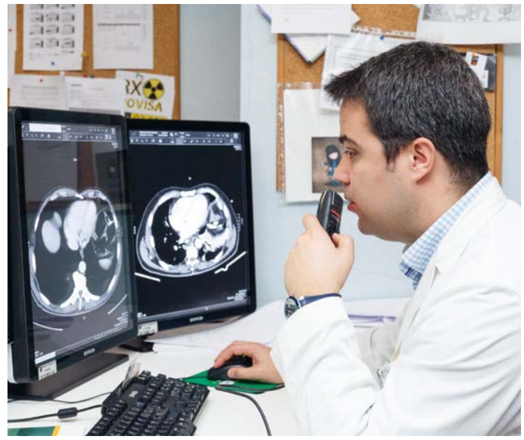
Radiographer José Antonio Vergara goes into the waiting room and then escorts the next patient, an elderly woman, into the examination room. He helps her get into the correct position on the table of the CT scanner. She looks a bit nervous, but thanks to the tablet, Vergara can stay at her side, speaking to her calmly, until the start of the scan.

"With the tablet," Vergara explains, "I can move around much more freely and stay with the patients longer because I don't have to constantly go back and forth between the CT and the control room to prepare the examination."

This is especially helpful when the patients are children who, like the elderly woman, tend to be nervous. And another plus for Vergara: "The patients move much less, so the image quality is better and scans don't have to be repeated because of motion in the images."

"The tablet frees us up to spend more time with our patients and make them feel more comfortable."

José Antonio Vergara
Radiographer, Povisa Hospital



Not least thanks to the technology it uses, Povisa Hospital was made one of Spain's nationwide radiology reference centers.

The CT scanner also eases the testing of patients with cognitive diseases such as Alzheimer's. "As soon as I'm in the control room," says Vergara, "patients often forget their instructions or sometimes don't even know where they are anymore, which of course makes the examination take much longer."

Patients feel better – and better cared for

Despite all the technical benefits the new controller has for the radiographer's work, he's more interested in what it does for the patients. "The patient always comes first," says Vergara, who has been working in the radiology department of Povisa Hospital for 21 years. "The controller frees us up to spend more time with our patients and make them feel more comfortable."

Radiologist Carlos Delgado agrees: "Being able to see them and not have to communicate with them through an intercom is incredibly important to many patients. They just feel better cared for when we're next to them. Together with fellow radiologists María Eloisa Santos and Gonzalo Tardáguila, Delgado was even able to prove this through an internal patient survey.

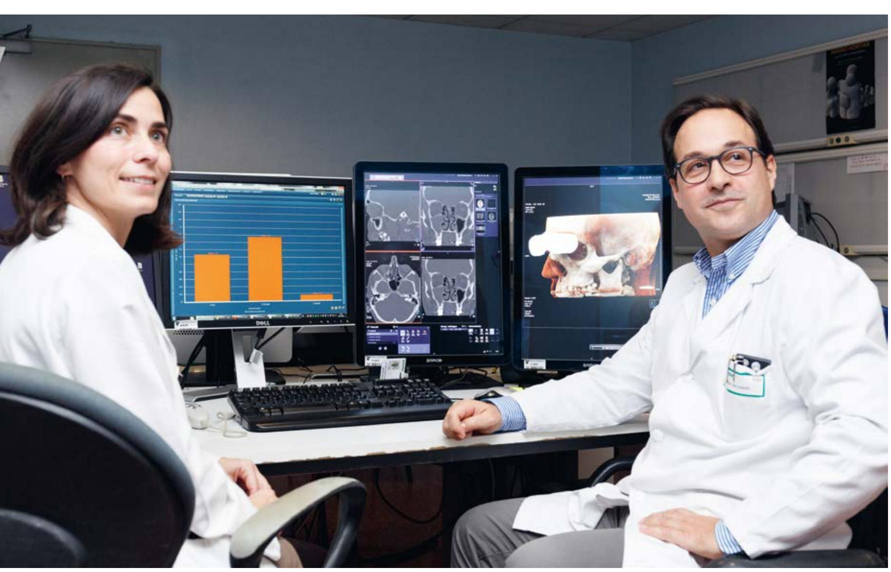
Over the course of several months, they divided their patients into two groups: For 33 patients, the examinations were prepared with the CT scanner and the tablet. While for 31 other patients, the examinations were prepared with a different CT scanner that didn't have the new tablet feature. They chose patients with an average age of 59 and 63, who had previous experience with CT scans, and then afterwards asked them about various aspects of their examination.

The result: 76 percent of the patients who received a scan using the CT scanner with the tablet felt "more accompanied", and 88 percent of the patients felt "better and more comfortable". Of the patients who received a scan without the tablet, only 47 percent said they felt "more accompanied", and only 73 percent thought they received "better care".

According to the survey, the tablet also gives the patients a positive impression that the CT scanner is more modern and advanced. At least 46 percent of the tablet-controlled group said the scanner was, in their opinion, "more advanced technology", while only 33 percent of the other group said the same.

Tablet control eases the workflow

In addition to more patient-friendly and faster examinations, the study also showed that the tablet and its associated one-room concept helped



Radiologists Carlos Delgado and María Eloisa Santos both see the low radiation dose of the new scanner as the main advantage.

"Being able to see them and not have to communicate with them through an intercom is incredibly important to many patients."

Carlos Delgado, MD
Radiologist, Povisa Hospital

the radiology department achieve real-time savings in their workflow. To do an examination of a patient without the tablet, the radiologists need an average of 7.29 minutes. But with the tablet, the scan can be done in 6.15 minutes.

"Of course, it sounds like a negligible gain," says radiologist Gonzalo Tardáguila, "but our study found that, subjectively, time passed much faster for our patients who received a scan with the tablet than for those who received a scan without it. Because they're in constant contact with the technician, the patients actually forget about time."

Low radiation for patients – high-quality images for radiologists

María Eloisa Santos and Carlos Delgado both see the low radiation dose of the new scanner as the main advantage. "Thanks to the Tin Filter and the Stellar detector, which allows iterative reconstruction, we're able to work with very low X-ray doses while maintaining high-quality images," says Santos, a neuroradiologist at Povisa.

The scanner already had a lower radiation dose than its predecessor models on the market. "However," says Santos, "we were able to reduce the dose in the scan protocols to such an extent that, to give just one example, we now need ten times less radiation for inner-ear examinations than we need using other scanners."

The older scanner requires a radiation dose of 1.25 millisieverts for inner-ear imaging, but with the new scanner, Santos can reduce the dose to 0.16 millisieverts. "What's more," the

The latest CT technology allows for very low X-ray doses while maintaining high-quality images – all for the benefit of the patient.

neuroradiologist adds, "we believe the image quality to be even better than high-end scanners." The team presented the findings of their 140-patient study last May at Spain's radiology conference in Pamplona.

It also proved to be possible for the Povisa radiologists to reduce the radiation dose for routine thoracic scans, from 5.5 millisieverts with the older scanner to 1.9 millisieverts with the new one, says chest radiologist Carlos Delgado. This reduction is even more extreme in lung screening examinations, where we are at levels comparable to a chest X-ray. And similar results were produced with head CT scans, where the radiation dose was significantly reduced.

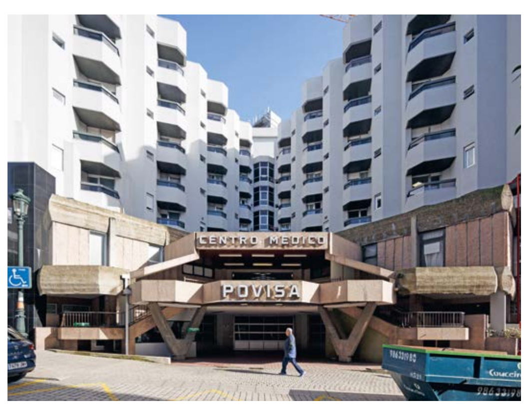
New EU directives: better radiation protection standard

In the field of pediatric radiology especially, and when examining sensitive organs such as the thyroid or mammary glands, explains department head Francisco Tardáguila, it's of enormous importance to work with the lowest possible radiation dose. The European Union takes a similar stance to Tardáguila. In February 2018, the EU introduced new guidelines with a better radiation protection standard. At the same time, it also called for patients to receive more and better information.

"Patients aren't familiar with radiation dosage or its consequences," says Tardáguila, "and it's up to us doctors to look out for the well-being of our patients and work with as little radiation as possible, even if the images might be better with more – that's why we're in such high demand here."

And that's why Povisa Hospital, as one of Spain's nationwide radiology reference centers, became the country's first hospital to launch the SOMATOM go.Up in 2017. In addition to other scanners with *syngo*.via, the hospital was also looking for a more cost-effective, yet fast, high-quality standard scanner with low radiation dose. ●

Manuel Meyer reports for *Ärzte-Zeitung*, a German newspaper for physicians and other medical professionals, from Spain and Portugal.



Apart from its own patients, the private Povisa Hospital in Vigo, Spain, also provides care for national health insurance patients.

[1] https://www.medscape.com/viewarticle/824151
[2] http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(14)70029-4/fulltext

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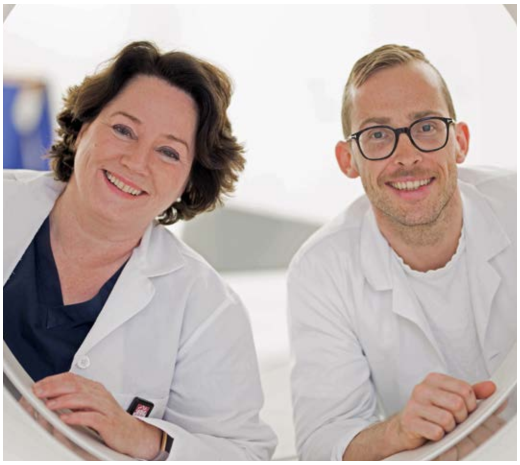
Speeding Up Cardiovascular Image Reconstruction

Many clinical issues in cardiology such as TAVI planning or the investigation of coronary arteries require very thorough preparation and monitoring. Computed tomography (CT) imaging is increasingly becoming the modality of choice. The help that new functionalities offer in reducing time and effort for radiologists and technicians as well as the standardized images it delivers is very welcome. Two European teams share their experiences.

Text: Wiebke Kathmann

Transcatheter aortic valve implantation (TAVI) has become a true alternative to surgical aortic valve replacement. For it to be successful, precise CT images of the complex 3D aortic root anatomy are needed. The decisions on who is eligible for TAVI, which kind of prostheses to select, and how big the device needs to be are based on data from CT imaging. Ultimately, the optimal anatomy-device-interaction determines the success of the procedure. Therefore, TAVI planning is of the utmost importance.



Happy about easier to read images and fewer clicks: Radiologist Signe Helene Forsdahl and resident radiologist Frode Tynes of the University Hospital of Northern Norway.

At the University Hospital of Northern Norway in Tromsø, surgeons first began TAVI interventions in 2008. In 2013, radiologist Signe Helene Forsdahl introduced CT imaging for TAVI pre-procedural planning, and by 2017, 112 CT scans for TAVI planning were performed in one year, resulting in 80 successful TAVI procedures. As Forsdahl points out, CT-based TAVI planning can be very tiresome and laborious: “The measurements have been done by as few people as possible for enhanced quality. It is the radiologist who does all the measurements and image reconstructions.” Understandably so, as it encompasses quite a number of repetitive measurements and images in order to best depict the individual anatomical situation of the patient.

Simplifying preprocedural TAVI planning

“Until two months ago, we moved through these steps manually,” resident radiologist Frode Tynes explains. Step-by-step they would do about 15 measurements of the diameter of the aorta along its anatomical path from the root to the pelvic region. At each step, they would write

Celestial imaging: northern lights in the Norwegian sky.

down the measurements manually, while also initiating and storing about the same number of images along the way. "The total work from opening the examination to finishing the report and processing of all the images including reading the thorax/abdomen/pelvis and "collecting" all the images in a special "TAVI-folder" for the surgeons in our PACS-system takes about 60 – 90 minutes."

"With the semi-automation provided by Cardiac Planning and Rapid Results it is a lot faster. A regular examination with good image quality takes only about 40 to 50 percent of the usual time."

Frode Tynes, resident radiologist, University Hospital of Northern Norway, Tromsø

Fewer clicks, easier image reading

"With the semi-automation provided by Cardiac Planning and Rapid Results it is a lot faster. A regular examination with good image quality takes only about 40 to 50 percent of the usual time. But what is more important than time saved is that we do not need to click so much anymore. That is the real benefit," states Tynes. For him, performing the pre-intervention CT planning of TAVI is no longer tiring as the steps are performed directly from the standard CT reconstruction task of the SOMATOM CT scanner in a semi-automated fashion.[1] "The workflow is much more efficient when doing TAVI planning the new way," says Tynes when recalling that he had done five TAVI planning procedures in a row the day before. "That would hardly have been possible before." With the guidance given by the protocol, this is easy.

For Forsdahl, semi-automation brought yet another benefit: "The semi-automation of the aortic valve has been valuable especially in examination with insufficient contrast and heavy annulus calcification. At the beginning it took time to trust the new software to find the annulus. After double-checking with the familiar, old-fashioned way several times, we now feel very sure about the results it provides." All in all, both state that it is a really good thing to get the same quality of results with less work. Considering the time and resources going into TAVI planning, both regard this as a big step forward. With the program being customized to the needs of the Tromsø team, they are getting exactly the measurements, images, and type of presentation they want for their surgeons.

Rapid Results in noninvasive CT coronary analysis

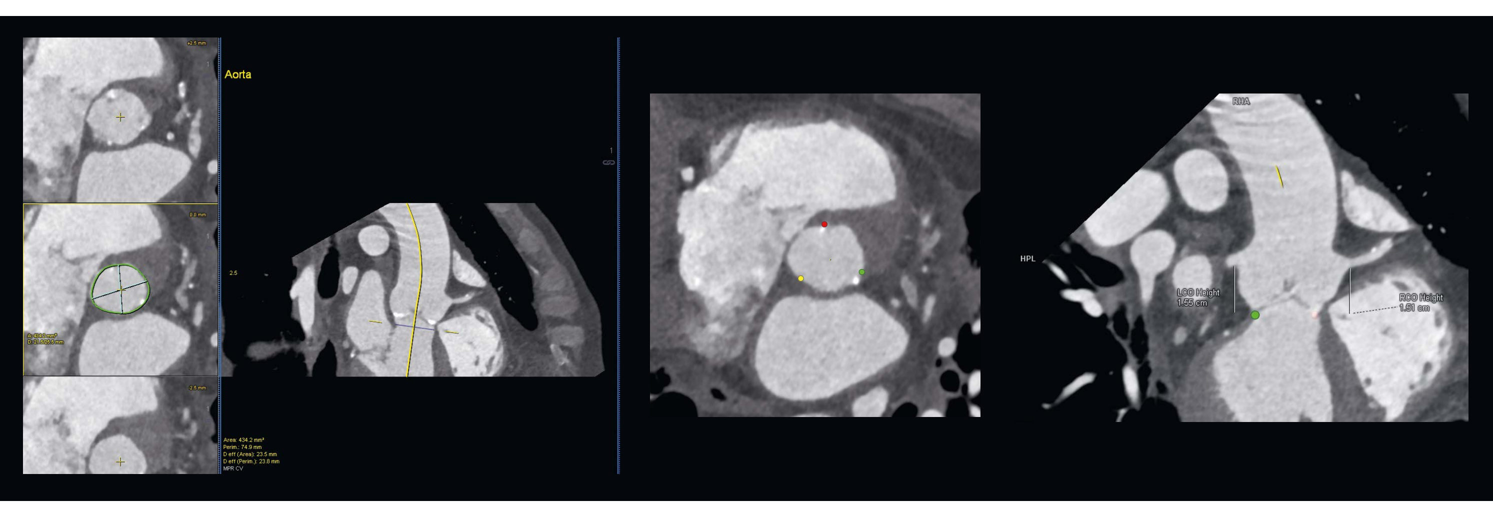
At the Institute for Diagnostic and Interventional Radiology and Neuroradiology at Essen University Hospital, Germany, the situation is somewhat different. The team there consists of 27 radiologists, 26 assistant physicians, and more than 60 technicians. Standardization, automation, and efficiency in image acquisition and reconstruction are key. As Sebastian Blex, Leading Technician and Head of the CT team at the institute, points out, they perform about 80 cardiac CT scans per month, mainly of the coronary arteries, partly for pre-interventional planning of TAVI. "With cardiac CT scans, we try to spare patients from having to undergo an invasive catheter exam," he states. To do so, they need precise views and data down to the smallest vessel of the coronary tree.

Extra gain: automatic curved multiplanar reconstructions

"Our interest in the new Rapid Results tool was sparked by the fact that it offers the time-consuming curved multiplanar reconstructions (cMPRs) as part of the package," explains Thomas Schlosser, Assistant Medical Director at the Institute. "It is a big advantage to have MPRs automatically assessed in a robust and reliable way and – what is clinically even more relevant – to have them sent to the PACS automatically. Thereby giving, not only everyone in the team, but also referring physicians access to the data. Many of them do not use *syngo*.via. Therefore, they would not be able to look at and evaluate

"It is a big advantage to have MPRs automatically assessed in a robust and reliable way and – what is clinically even more relevant – to have them sent to the PACS automatically."

Thomas Schlosser, MD, Institute for Diagnostic and Interventional Radiology and Neuroradiology at Essen University Hospital, Germany



A 57-year-old man with lymphoma received aggressive chemotherapy. The assessment with *syngo*.CT Cardiac Planning and Rapid Results revealed an aortic stenosis and cardiac insufficiency. *Courtesy of University Hospital of Northern Norway in Tromsø.*

Happy about time-savings: Sebastian Blex, Leading Technician and Head of the CT team (left), and Thomas Schlosser, MD, of Essen University Hospital.

the CT images otherwise." Besides, the automated visualization provides an opportunity for referrers who are less trained in reading CT images to get a simple and fast overview, while also allowing for an improved interpretation of pathological alterations compared with the normal dataset. "In TAVI planning, where Rapid Results can now generate parallel and radial ranges of the aorta and run-offs, physicians can more easily assess whether to expect complicating issues like plaques, aneurysms, or dissections while implanting the prosthesis."

Significant time-saving

The key point for Schlosser in using the extensive automated reconstruction function is the significant saving of time. "As the automated reconstruction is very reliable, we hardly ever need to perform manual modifications – the exception being individual anatomical peculiarities like very thin arteries." Added to this, according to Blex, technicians save up to 20 minutes per case with the reconstruction being done automatically.

Both experts from Essen emphasize the benefit of standardization. For the radiologist, reading the CT images has become easier and faster, which in turn makes reporting easier. For the technician, the benefit lies more in not needing to structure the image generation himself. He can rely on the program to guide him. "I only need to double-check the results while following along the arteries and looking for a constriction," Blex explains. "Besides, there is less room for individual preferences of users within the team, which makes things more reproducible and therefore easier." ●

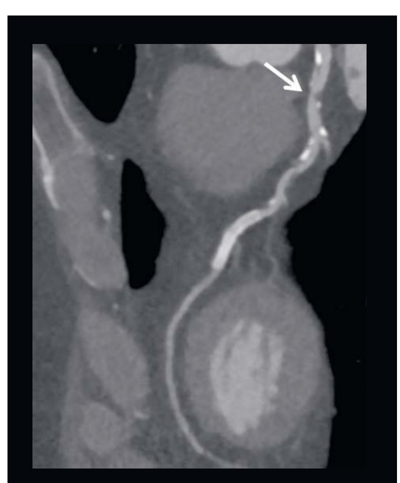
"As the automated reconstruction is very reliable, we hardly ever need to perform manual modifications."

Sebastian Blex, Leading Technician and Head of the CT team

Wiebke Kathmann holds a Master's in Biology and a PhD in Theoretical Medicine. She became a freelance medical writer in 1999 and is a frequent contributor to medical magazines.

Reference

[1] Horehledova B, et al. Aortic root evaluation prior to transcatheter aortic valve implantation-Correlation of manual and semi-automatic measurements. PLoS One. June 28, 2018;13(6).



A 63-year-old patient with HCC and known CHD with a previous LAD stent implantation 12 years ago. CT coronary angiography performed as part of LTx evaluation showed a high-grade proximal LAD stenosis (arrow). *Courtesy of Essen University Hospital, Germany*

Improving the Big Picture: CT Flowmaster Transcends Departmental Boundaries

The CT Innovation Unit at Herlev Hospital in Denmark has organized, tested, and implemented a more efficient way of using their available CT scanners for acute patients by creating the position of "Flowmaster". The result is improved patient safety, more cost-efficient care, less waiting time for physicians after having ordered a CT scan, and staff who are better able to focus on their main tasks instead of administrative work.

Text: Nils Lindstrand | Photos: Jan Sondergaard

Fast and mobile: The Flowmaster is in contact with doctors and staff beyond the radiology department.

Herlev Hospital is a skyscraper, actually the tallest building in Denmark, rising 120 meters over the town of Herlev on the northern outskirts of Copenhagen. But Herlev Hospital excels in other ways as well. To ensure the best possible use of the radiology department, the Capital Region of Denmark and Siemens Healthineers joined forces in 2013 to create the first Danish CT Innovation Unit. The Unit comprises representatives from all different teams, radiographers, doctors, and managers.

"We are the only Innovation Unit at departmental level at Herlev Hospital," says project manager Henriette Raaschou. "But serving all other departments, be they cardiology, neurology, or

On the go: The Flowmaster, a position held by a member of the radiological team, ensures an efficient workflow.

trauma units, our work has the potential to impact the entire hospital. You could argue that the staff members at the department of radiology are the last generalists in healthcare, involved in the care of all kinds of patients."

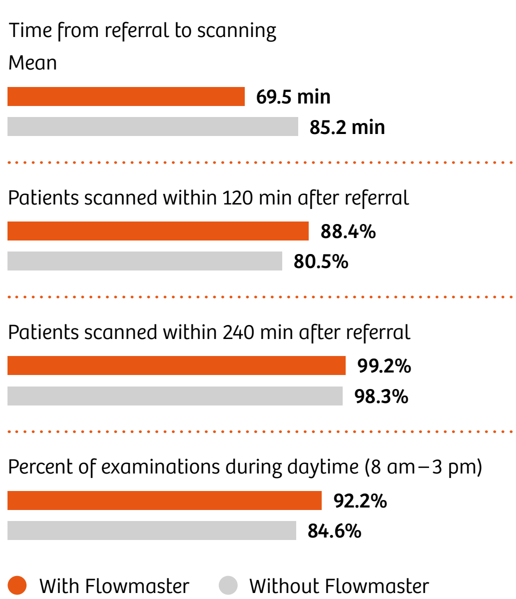
Optimizing workflow

The radiology department at Herlev Hospital has seven CT scanners, with one traditionally being used for acute patients. By scanning 65 acute patients on a normal day, the patient volume is high at the Danish hospital. And sometimes, even one dedicated acute scanner is not enough. Keeping in mind that the quicker acute patients are scanned and diagnosed, the quicker they can get the correct care, it is crucial to establish an efficient CT workflow – from ordering a CT to the scanning itself and from managing patient load in a smart way to keeping patient safety high, while at the same time utilizing all available scanners optimally. This can be particularly challenging, because all the department's other scanners are mostly fully booked, especially during peak hours. So the CT Innovation Unit identified the need for an overall workflow improvement regarding the CT management, with special attention placed on relieving staff and using their competencies optimally. To be more concrete, the goal for the radiographers was to be able to focus on the scanning process and for the

The Flowmaster's main task is keeping an overview of the workflow.

radiologists to be able to concentrate on the analysis, ideally with someone else taking care of the workflow optimization. The result of this discussion was the creation of the Flowmaster position.

Measurements with and without a CT Flowmaster at Herlev Hospital



"It's a bit like the work of an air traffic controller," says Felix Müller, MD, one of the doctors in the CT Innovation Unit. "One person takes on the single task of having an overview of the flow, making sure that the staff and equipment are working efficiently. When this works, the scanners are all used optimally at any given time, and no staff or equipment is ever idle."

Significantly shorter scanning procedure

This new system was first tested in November and December of 2017. Over a period of six weeks, the scanning department alternately worked with and without a Flowmaster, first every other week, then two weeks at a time. The result was very positive: "We were able to scan more patients during 'daytime' – that is, before 3 pm," says Müller, "and the average time from ordering a CT scan until the time the patient is scanned was reduced by more than 20 percent."

The majority of patients in the highest priority group are scanned within one hour, and, in the second priority group, where patients are to be scanned within two hours, almost every patient was scanned in time. "We are very happy to be able to guarantee this," the doctor says.

Higher equipment utilization and efficiency

The goal of using the equipment more efficiently also seems to have been reached. "There is far less dead time when a Flowmaster is working", says Henriette Raaschou. "He or she manages to steer patients to an available scanner very efficiently."

Improved safety for patients and a more efficient use of all resources are thus two goals achieved by the Flowmaster approach. The third goal, more room for the staff to focus on their main tasks, seems to have been achieved as well: "Especially during peak hours, the advantage of having a Flowmaster in contact with the doctors and other staff beyond the radiology department is great," says radiographer Ulrik Frost. "This means we can focus on the scanning process without being distracted, by patients arriving late, for example."

The Flowmaster manages patient flow and makes sure that the scanners are utilized optimally.

Bottom-up approach

The Flowmaster project was accomplished within an unusually short time period. One reason for this was that the necessity to improve organization was identified within the department itself, by the Innovation Unit at the radiology department and by the people scanning patients every day. This bottom-up approach was the reason why all staff members involved were highly committed.

During the weeks when the two systems, with and without a Flowmaster, were alternating, the staff were interviewed at the end of each workday to map how the difference was perceived. By engaging the staff in this way, the project was, in many ways, being implemented at the same time as it was being tested and evaluated.

It was with the same efficiency that the management decided, in March of 2018, to make the Flowmaster a permanent position within the radiology department, meaning that one member of staff would always have the specific task of maintaining an overview.

"One person takes on the single task of having an overview of the flow, making sure that the staff and equipment are working efficiently."

Felix Müller, MD

Innovation is key

"The management has been very dedicated to this project and to the creation of the Innovation Unit," says Henriette Raaschou. She has been working at Herlev Hospital as a radiographer and has now been given the opportunity to do a Master's degree in leadership and innovation in complex systems, to give her and the hospital better tools to continue working with innovation.

"I think it's important for innovation in medical care to focus on the workflow, on the big picture, and not on individual systems or persons," she says. "This means that we need to give innovation much more attention than we do currently. The use of innovative approaches can create additional value, which in turn has the potential to affect the whole hospital." ●

Nils Lindstrand has been working as a science writer and journalist for more than 30 years. He is based in Stockholm.

Coimbra Opts for Patient-friendly Technology of the Future

Hospitals in Portugal are struggling with growing patient numbers, a lack of personnel, and budget cuts. Even so, the department of radiology at the university hospital in Coimbra has managed to improve the quality of medical care by harnessing the latest technology.

Text: Manuel Meyer | Photos: André Boto

Pedro Belo Oliveira, MD, radiologist at the Coimbra University Hospital Centre.

Coimbra is a real jewel. The town's university, with its world-famous library, is a UNESCO World Heritage Site. Founded way back in 1290, it is one of the oldest universities in the world. High above the hilly historic district, it looks down on Moorish city gates, churches, and chapels dating back to the twelfth century.

Despite the wealth of tourist attractions, the tranquil student town between Lisbon and Porto, only 50 kilometers from the roaring Atlantic Ocean, is a peaceful place. "When the 30,000 or so students go on vacation, Coimbra feels almost dead," says radiologist Pedro Belo Oliveira, MD. Unfortunately, he can't say the same for the department of radiology at the Coimbra University Hospital Centre (CHUC).

On the contrary: "Patient numbers have been steadily increasing for years," explains Oliveira. In 2012, they did 58,992 CT scans and 12,438 MRIs; last year it was 75,357 CT scans and 16,482 MRIs. Over the same period, the number of CT-guided interventions almost tripled from 2,235 to 6,270.

Biggest hospital in the country

The main reason for this huge growth in patient numbers is the effort to restructure the Portuguese healthcare system. In 2011, in the wake of the major economic crisis, six of the city's healthcare centers were merged with the university hospital to create the Coimbra University Hospital Centre (CHUC), the biggest hospital in Portugal, with 7,700 employees, 1,800 beds, and 1.2 million patients a year. Around 62,000 operations are done annually at CHUC.

But according to Oliveira, there's another reason why the university hospital's direct catchment area has risen to almost three million people: "All over Portugal, CHUC has become the reference in areas including bone tumor treatment, cardiothoracic surgery, kidney and liver transplants, and endovascular treatment on neuroradiology."

So patients aren't just coming from Coimbra and other cities in central Portugal, but also from all parts of the country, including the Portuguese islands of Madeira and the Azores in the Atlantic, and former colonies such as Angola and Cape Verde. As a consequence, "every year, 575,000 diagnostic imaging examinations are carried out at Coimbra University Hospital Centre. Depending on emergencies, an average of 206 CT examinations are performed each day."

Coimbra University Hospital Centre (CHUC)

7,700 employees,
1,800 beds,
1.2 million patients a year.
Around **62,000** operations are done annually at CHUC.

This is a lot for the 50 physicians (32 radiologists and 18 neuroradiologists) and X-ray technicians to handle. They work in two shifts from 8 a.m. to 8 p.m. Until recently, the situation was made even worse by a hiring freeze and the fact that radiologists were abandoning the public system for the private sector.

But Portugal is slowly recovering from the effects of the financial crisis. More is being invested in the public health system. Among other things,

Radiologist Pedro Belo Oliveira, MD reckons that they have been able to reduce the dose of contrast agent since the SOMATOM go.All arrived.

this has enabled CHUC to invest in a new CT scanner, something that had long been needed. The department of radiology chose the SOMATOM go.All system. “Besides being a very good value for the money, we anticipated two main advantages from our new CT scanner: Quicker operation, and the ability to operate with lower doses of contrast agent and radiation,” explains Oliveira.

Patient-friendly, economical, and high-quality

Were these expectations met? “Absolutely! Thanks to the new scanner, we’re now much more efficient and patient-friendly.” He estimates that they now require five minutes less for each patient on average. Above all, however, Oliveira emphasizes the lower doses of contrast agent and radiation: “The new technology has already paid huge dividends.”
Pedro Belo Oliveira vividly remembers a patient with an abdominal aortic aneurysm who needed rapid intervention for renal dysfunction. “The fact that we could work so rapidly and with less contrast agent was of vital importance.”

The radiologist reckons that on average they’ve been able to reduce the dose of contrast agent. That’s a welcome side effect at a time where budgets are stretched to the limit, because reduced consumption of contrast agent also means lower operating costs. He also says that the doses of radiation they now operate with are up to three times lower than with other equipment. “And all this with absolutely the same high level of image quality,” says Oliveira.

Intuitive, easy-to-use software

Radiographer Tiago Araújo is also excited about the new CT scanner, particularly its “extremely intuitive and easy-to-use software.” He explains that because the scan protocol includes all scan areas as standard, it only takes a few clicks to launch the imaging process. “After that, the scanning and operating protocols automatically take care of postprocessing, which makes work even more efficient," says Araújo.

He explains that particularly when it comes to difficult manual postprocessing, for example in cases involving metallic elements such as prostheses, the software is much quicker and more precise than a radiographer.

Araújo's fellow radiographer Teresa Rodrigues says that tablet and remote control also makes work much more efficient. "Because I no longer have to constantly switch between the X-ray room and the control room, I can spend most of the time with the patient." That saves time and creates a calmer atmosphere for both the staff and the people they're scanning.

More reassuring setting for patients

Perhaps the most important advantage of the tablet and remote control function is "the fact you can spend so much time with the patient and maintain eye contact, which makes them feel more at ease than if you can only talk to them over the intercom from the control room. That's particularly important for children and people with claustrophobia or other anxieties." After all, as Rodrigues points out, many of the patients lying in the CT scanner have a tumor and are expecting bad news.

"It's definitely the technology of the future."

Pedro Belo Oliveira, MD, radiologist at the Coimbra University Hospital Centre, Portugal

If patients are nervous and move around a lot, poor images can result and sometimes even time-consuming repeat scans become necessary. The tablet and remote control function is incredibly helpful for patients with dementia. Often, these people forget what to do or even where they are.

"It's definitely the technology of the future, so I'm really glad we have it. As a research and university hospital, we're also responsible for training future generations of physicians. This way, they get to learn how to work with technologies at the leading edge," says radiologist Pedro Belo Oliveira. ●

Manuel Meyer reports from Spain and Portugal for the German medical newspaper ÄrzteZeitung.

Radiographer Tiago Araújo likes the SOMATOM go.All, particularly its intuitive and easy-to-use software.

Multiple Arteriovenous Fistulas in the Left Lower Limb

By Xing Liu, MD*; Xi Zhao, MD**
*Department of Radiology, First Affiliated Hospital of Zhengzhou University, Zhengzhou, P. R. China
**Siemens Healthineers China

History

A 63-year-old male patient, who has been suffering from venous varicosity of the left lower limb for the past 30 years came to the hospital for a checkup. Physical examinations revealed a mild swelling of the left lower limb with prominent varicosity. An ulcerated area, measuring 3 × 5 cm in size, was visible on the lateral side. A Dual Energy (DE) CT angiography (CTA) was performed to investigate the cause of the varicosity.

Diagnosis

DE CTA images showed four arteriovenous fistulas (AVFs) in the left lower limb (Fig. 1d). Two arterial feeders issued from the distal popliteal artery, right above the bifurcation of the posterior tibial and the fibular arteries. Another two came off the proximal anterior tibial artery. Malformed blood vessels were shown in three areas, and the ulcerated area was fed by two arteries – one from the distal popliteal artery and the other from the proximal anterior tibial artery. Subsequently, the patient was scheduled for an interventional treatment.

Comments

AVFs are anomalously formed by a single vascular channel between an artery and a vein, diverting blood from the normal anatomic capillary beds. Although digital subtraction angiography (DSA) is the gold standard for diagnosing vascular disorders including AVFs, it is invasive and needs to

Examination Protocol

Scanner	SOMATOM Force		
Scan area	Lower extremity	Rotation time	0.5 s
Scan mode	Dual Source Dual Energy	Pitch	0.6
Scan length	1,116 mm	Slice collimation	128 × 0.6 mm
Scan direction	Cranio-caudal	Slice width	1.5 mm
Scan time	24 s	Reconstruction increment	1.0 mm
Tube voltage	70 / Sn150 kV	Reconstruction kernel	Qr40 (ADMIRE 3)
Effective mAs	110 / 37 mAs	Contrast	350 mgL/mL
Dose modulation	CARE Dose4D™	Volume	60 mL + 50 mL saline
$CTDI_{vol}$	2.55 mGy	Flow rate	5 mL/s
DLP	292 mGy cm	Start delay	Bolus tracking in the abdominal aorta @100 HU + 7 s

be performed by a specialist team. CTA can serve as the initial imaging study, since it is noninvasive and easily accessible. In this case, DE CTA was performed and the contrast enhancement was compared between the linearly blended images and the images displayed at 45 keV using DE Monoenergetic Plus – an algorithm that performs a regional spatial frequency-based recombination of the high signal at lower energies and the superior noise properties at medium energies to optimize contrast-to-noise ratio (CNR).[1] The contrast of the distal vessels is significantly enhanced at 45 keV, thus depicting small vascular details and providing an important guidance for the interventional treatment. ●

Reference

[1] Grant KL, Flohr TG, Krauss B, et al. (2014) Assessment of an advanced image-based technique to calculate virtual monoenergetic computed tomographic images from a dual-energy examination to improve contrast-to-noise ratio in examinations using iodinated contrast media. Invest Radiol. 2014 Sep;49(9):586–592.

1a 1b 1c 1d

1 Cinematic VRT images show the runoff (Fig. 1a and Fig. 1b) and the four identified AVFs (arrows) in the left lower limb (Fig. 1c and Fig. 1d). Although the same preset is applied, the small vascular details are more clearly depicted in the images displayed at 45 keV (Fig. 1b and Fig. 1d) than in the linearly blended images (Fig. 1a and Fig. 1c). This is due to a much higher contrast enhancement. The ulcerated area (arrowhead) is fed by two arteries – one from the distal popliteal artery (short white arrow) and another from the proximal anterior tibial artery (long white arrow).

Endoleak After Endovascular Aneurysm Repair

By Marcel L. Dijkshoorn; Ricardo P.J. Budde, MD, PhD
Department of Radiology and Nuclear Medicine, Erasmus MC, Rotterdam, The Netherlands

History

A 77-year-old male patient, with a history of coronary artery bypass grafting and hypertension, had undergone endovascular aortic aneurysm repair (EVAR) in 2012. Four years later, the EVAR had been extended into the left internal and external iliac artery, due to a distal type I endoleak. In a recent routine follow-up, a dynamic abdominal CT angiography (CTA) was requested to rule out a suspected endoleak.

Diagnosis

The dynamic CTA images revealed a hyperdensity in the infrarenal AAA sac, as well as a lumbar feeding artery, characterizing a type II endoleak. A severe stenosis of the proximal left renal artery is also seen.

Comments

EVAR is a percutaneously performed procedure to repair an AAA using synthetic graft and stents. An endoleak is defined as a leak into the aneurysm sac after endovascular repair. A type II endoleak is the most common but least serious of five different types. The leak is characterized by a retrograde flow to the aneurysm sac from arterial branches such as the lumbar artery. Although it does not require immediate treatment, lifelong follow-up is necessary. For appropriate patient management, it is not only important to detect the endoleak but also to define its source, i.e., the feeding artery. The challenge of a standard CTA is the lack of dynamic information. The best imaging phase and the combination of imaging phases remain a matter of debate. While an acquisition in the arterial phase is suitable for defining the source of the endoleak, it may miss the visualization of the endoleaks that have a delayed filling. Scanning in a delayed phase will not properly show the feeding artery due to diminished arterial opacification. An additional invasive angiogram may then be needed.

In this case, a dynamic CTA was performed using Adaptive 4D Spiral scanning. It shows that the endoleak is

Examination Protocol

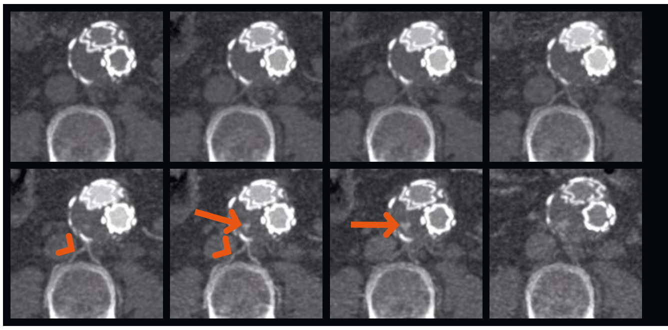
Scanner	SOMATOM Edge Plus		
Scan area	Abdomen/pelvis	**Rotation time**	0.28 s
Scan mode	Adaptive 4D Spiral	**Slice collimation**	128 × 0.6 mm
Scan length	282.4 mm	**Slice width**	1.5 mm
Scan direction	Shuttle	**Reconstruction increment**	0.8 mm
Scan time	30.5 s*	**Reconstruction kernel**	Br32
Tube voltage	80 kV	**Contrast**	320 mgL/mL
Effective mAs	110 mAs	**Volume**	90 mL + 40 mL saline
Dose modulation	CARE Dose4D™	**Flow rate**	5 mL/s
$CTDI_{vol}$	35.8 mGy	**Start delay**	Bolus tracking in left atrium
DLP	1,035.1 mGy cm		

* 7 acquisitions at an interval of 2.5 seconds for the first 15 seconds, followed by 4 acquisitions at an interval of 5 seconds, and 3 acquisitions at an interval of 7 seconds in a total scan duration of 58 s.

best seen 26 seconds after the beginning of the scan, which is 10 seconds after the peak arterial enhancement. A lumbar artery as the source of the endoleak is also clearly demonstrated, using the fused temporal maximum intensity projection (MIP) images. As dynamic CTA requires multiple scans and may result in an increased radiation dose compared with a single or dual-phase CTA, it can be used as an imaging strategy in cases where standard CTA does not clearly define the source of an endoleak, or if an endoleak is not shown but suspected due to an increasing or non-diminishing size of the aneurysm sac. Additionally, lower kV and mAs settings for each time point acquisition, as well as longer scan intervals after the arterial enhancement peak, should be applied to improve contrast-to-noise ratio (CNR) and to reduce radiation dose. ●

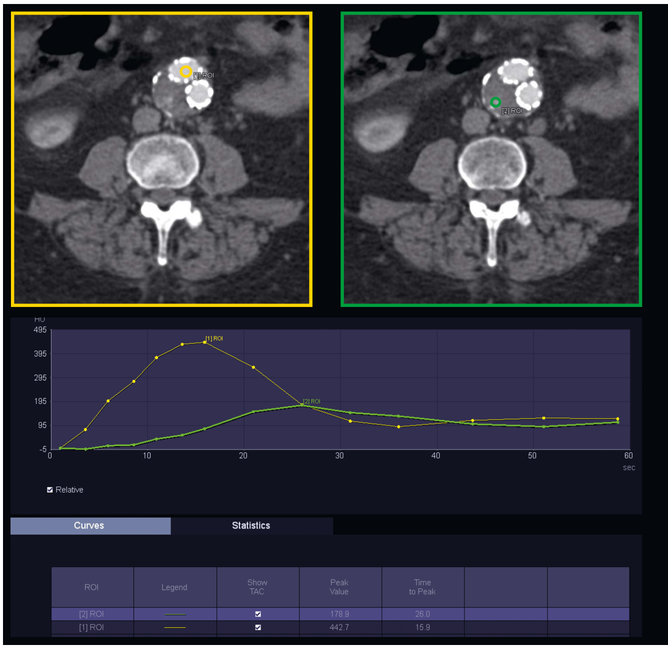
The outcomes by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other customers will achieve the same results.

1



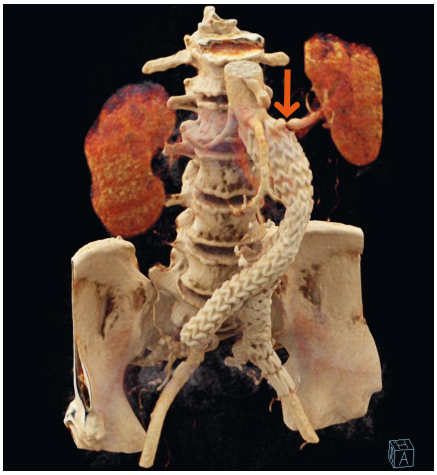
1 MIP images (9 mm) selected at time points of 0-5-10-12-16-20-26 and 35 seconds post scan start show an endoleak contrast blush (arrow) and the feeding lumbar artery (arrowhead).

2



2 Time attenuation curves (TAC) of the stent lumen (ROI 1, in yellow) and the endoleak blush (ROI 2, in green) demonstrate the peak enhancement (ROI 1: 16 s, ROI 2: 26 s) and the washout of the contrast. Note that a standard CTA acquired at the aortic peak enhancement would have been too early to optimally visualize the endoleak. Ensuring the correct timing for a second late scan would also be difficult without prior knowledge of the washout dynamics of the endoleak.

3a



3b

4

3 Cinematic VRT images show the stent configuration in its complete length within a scan range of 28 cm (a), as well as the endoleak (b, arrow) and the feeding lumbar artery (b, arrowhead) in a zoomed sagittal view. A severe stenosis in the proximal left renal artery (a, arrow) is also seen.

4 A sagittal view of temporal MIP fused with 12 time points around the peak enhancement shows the endoleak (arrow) and the feeding lumbar artery (arrowhead).

Takayasu Arteritis Treated by Aortic Stenting

By Professor Marilyn Siegel, MD
Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri, USA

History

An 11-year-old girl with Takayasu arteritis and abdominal aortic narrowing underwent stent placement. A Dual Energy CT (DECT) examination was performed to evaluate the size of the aorta, the stent integrity, and the need for additional surgery.

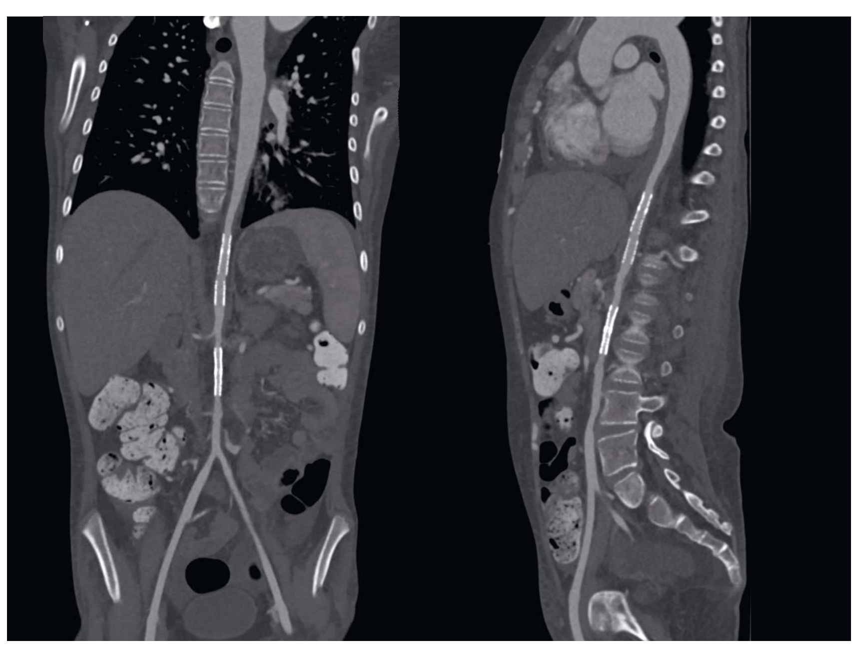
Diagnosis

DECT images revealed a normal-caliber thoracic aorta and marked narrowing of the entire abdominal aorta, beginning just above the level of the diaphragmatic hiatus and extending into bilateral proximal common iliac arteries. Three patent stents were present within the abdominal aorta – two above the level of the celiac artery and the third in the infrarenal abdominal aorta (Fig. 1). These, along with collateral vessels arising from the dilated internal mammary, the superior and the inferior mesenteric arteries, were also demonstrated in 3D reconstructions using both conventional volume rendering technique (VRT) (Fig. 2a) and cinematic VRT (cVRT) (Figs. 2b–2d).

Comments

Takayasu arteritis is a large-vessel vasculitis that affects the aorta and its major branches. In patients with symptomatic stenotic or occlusive lesions, percutaneous transluminal angioplasty and stenting or bypass surgery are common palliative treatments. It is particularly important to identify and characterize areas of stenoses and collateral vessel formation on CT images in guiding surgical planning and avoiding morbidity from vascular injury. DECT allows for an automated workflow of bone removal, using *syngo*.CT DE Direct Angio, to generate free views of CT angiographic (CTA) images. Compared with conventional VRT, cVRT images demonstrate a better 3D perspective with improved depth and shape perceptions, allowing for a lifelike demonstration. In this follow-up case, an overview of the entire aorta, the patency of the stents, the pulmonary vessels, as well as the origin and caliber of the collateral vessels were clearly presented to both radiologists and referring physicians. ●

1a 1b



1 Curved MPR images show marked narrowing of the entire abdominal aorta and three intraluminal patent stents.

2a 2b 2c 2d

Examination Protocol

Scanner	SOMATOM Definition Flash
Scan area	CAP
Scan mode	Dual Source Dual Energy
Scan length	536 mm
Scan direction	Cranio-caudal
Scan time	3.5 s
Tube voltage	80 / Sn140 kV
Effective mAs	90 / 41 mAs
Dose modulation	CARE Dose4D™
$CTDI_{vol}$	3.26 mGy
DLP	207.5 mGy cm
Rotation time	0.28 s
Pitch	1.2
Slice collimation	128 × 0.6 mm
Slice width	1.0 mm
Reconstruction increment	1.0 mm
Reconstruction kernel	130f
Contrast	320 mgI/mL
Volume	100 mL
Flow rate	2 mL/s
Start delay	Bolus tracking

2 VRT (Fig. 2a) and cVRT (Figs. 2b–2d) images show aortic narrowing, luminal stents, and collateral pathways arising from internal mammary vessels and mesenteric arteries. Note that cVRT images demonstrate a more realistic representation for much better anatomical and depth perception.

Traumatic Bone Marrow Edema of the Lower Limb

By Professor Sachin Khanduri, MD
Department of Radiodiagnosis, Era's Lucknow Medical College, Lucknow, India

History

A 35-year-old male patient, complaining of pain in the right knee following a road traffic accident four hours ago, presented to the emergency department. Physical examinations revealed no external wounds around the right knee joint. The X-ray examination was negative. Dual Energy CT (DECT) was requested for further evaluation.

Diagnosis

DECT images showed a hyperdense area on the lateral aspect of the right proximal tibia, suggesting a bone marrow edema. No signs of fracture were seen in CT images. Magnetic resonance imaging (MRI), performed the same day, ruled out ligamentous injuries and confirmed bone marrow edema in the same area.

Examination Protocol

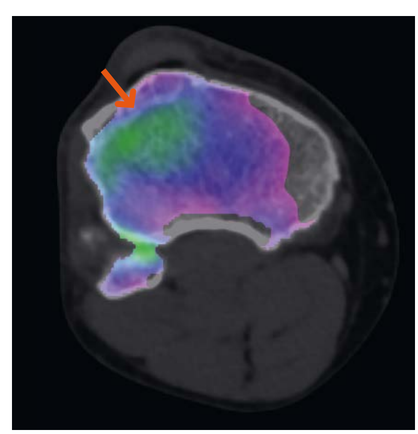
Scanner	SOMATOM Force		
Scan area	Knee joints	**$CTDI_{vol}$**	6.67 mGy
Scan mode	Dual Source Dual Energy	**DLP**	184.5 mGy cm
Scan length	245.7 mm	**Rotation time**	0.5 s
Scan direction	Cranio-caudal	**Pitch**	0.6
Scan time	5.2 s	**Slice collimation**	128 × 0.6 mm
Tube voltage	80 / Sn150 kV	**Slice width**	1.0 mm
Effective mAs	161 / 108 mAs	**Reconstruction increment**	0.7 mm
Dose modulation	CARE Dose4D™	**Reconstruction kernel**	Qr44 (ADMIRE 4)

The outcomes by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other customers will achieve the same results.

In clinical practice, the use of ADMIRE 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.

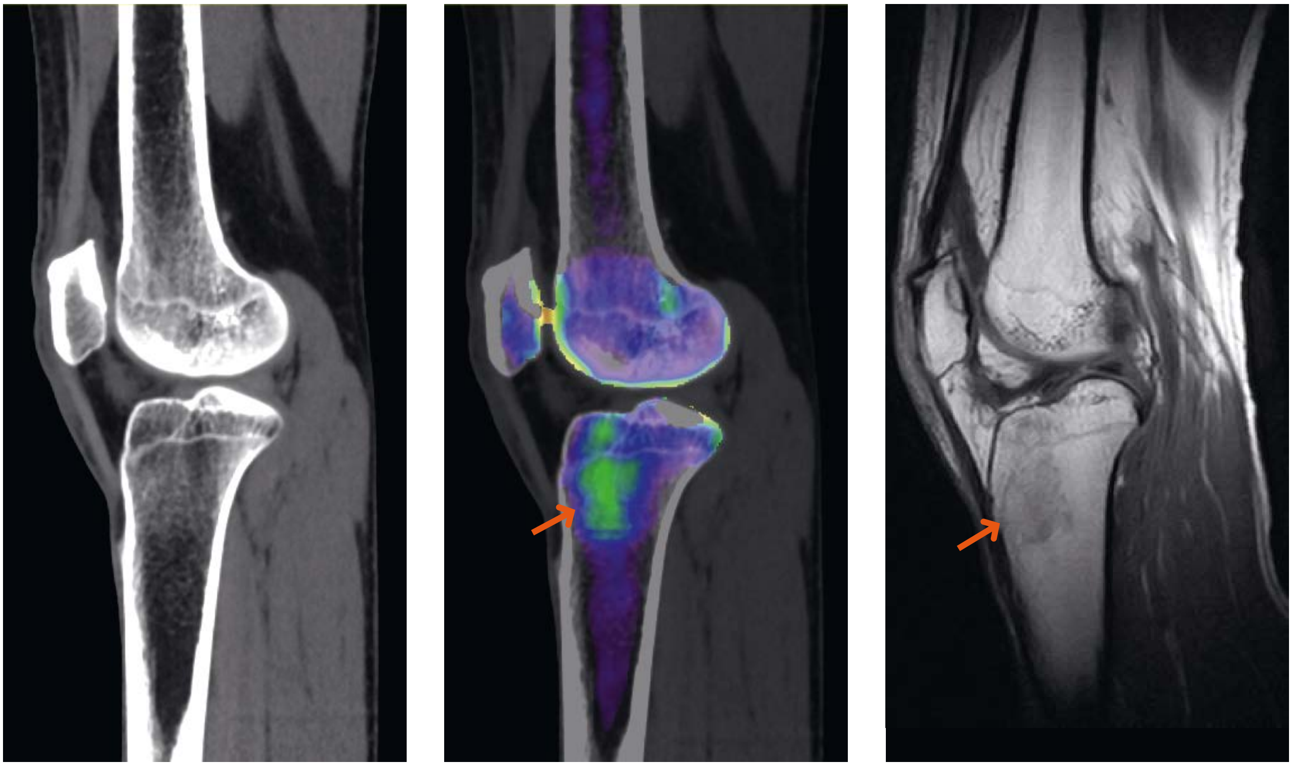
Comments

Bone marrow edema, usually caused by trauma, is hardly detectable in conventional CT imaging since it produces very subtle changes in CT attenuation values and densities. To overcome this challenge, a new application named *syngo*.CT DE Bone Marrow was introduced. It acquires the attenuation measurements from two different kV settings and calculates a virtual non-calcium (VNCa) image, using the three-material decomposition method. To further improve the assessment of the marrow space, a special filter technique (Tin Filter), the Selective Photon Shield, is also applied, enabling a significant separation of the energy spectrum at 80 and 150 kV settings. In this case, CT assessment helped the physicians reach a confident diagnosis.



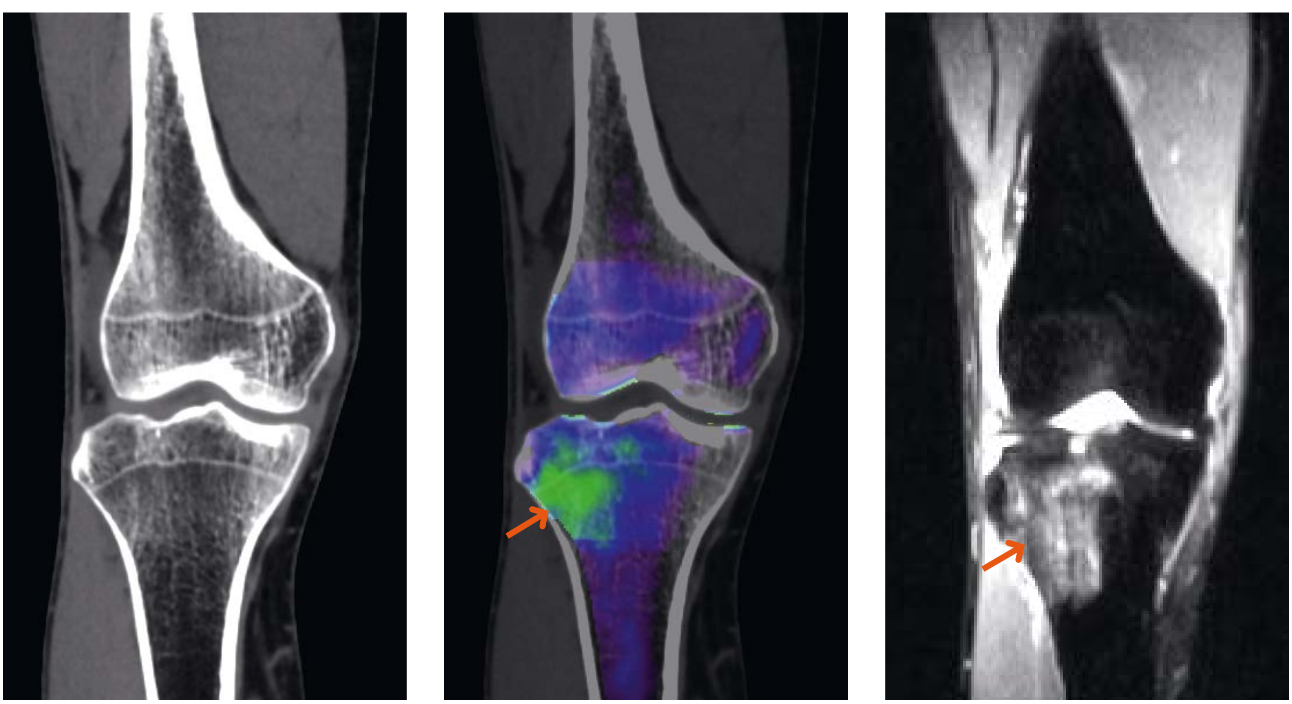
1 An axial DE VNCa image depicts bone marrow edema (arrow) on the lateral aspect of the upper right tibia.

2a 2b 2c



2 Sagittal views of a CT (Fig. 2a), a DE VNCa (Fig. 2b), and a T1-weighted MR (Fig. 2c) image of the right knee joint show no fractures but bone marrow edema (arrows) on the lateral aspect of the proximal tibia.

3a 3b 3c



3 Coronal views of a CT (Fig. 3a), a DE VNCa (Fig. 3b), and a STIR MR (Fig. 3c) image of the right knee joint show no fractures but bone marrow edema (arrows) on the lateral aspect of the proximal tibia.

A Large Mesenteric Pleomorphic Sarcoma – Where to Target a Biopsy?

By Professor Arvind K Chaturvedi, MD; Ankush Jajodia, MD
Department of Radiology, Rajiv Gandhi Cancer Institute and Research Centre, New Delhi, India

History

A 58-year-old male patient, who has been suffering from chronic liver disease with portal hypertension for the past 12 years, presented to the hospital due to abdominal distension for the past month. Hepatocellular carcinoma was suspected, and a TwinBeam Dual Energy (TBDE) CT scan was ordered for assessment.

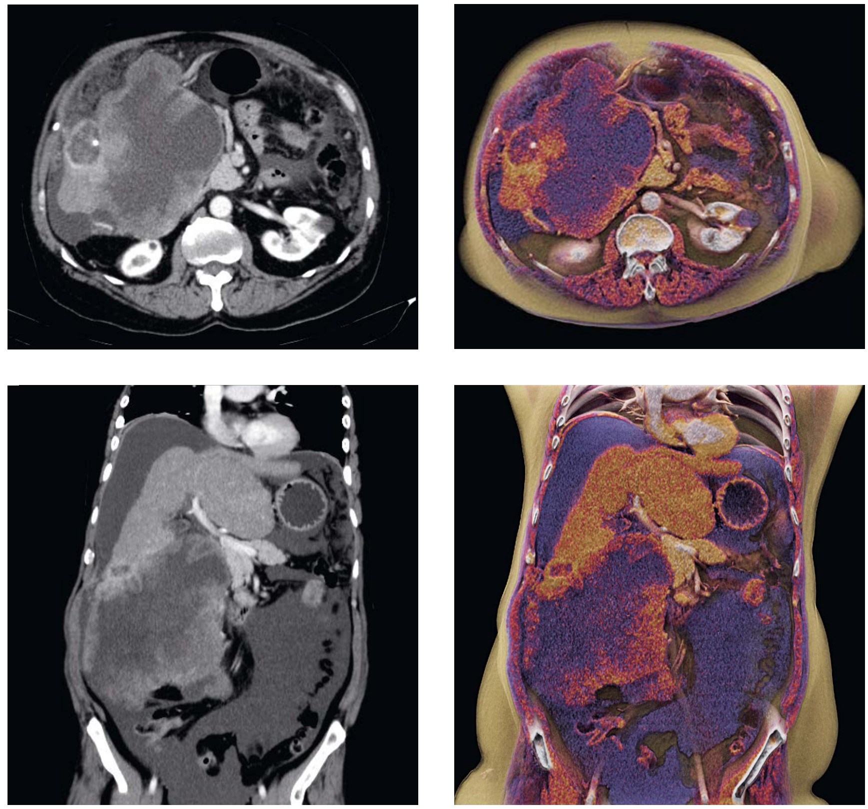
Diagnosis

CT images revealed a bulky lobulated mesenteric mass in the right hypochondrial-lumbar region, measuring approx. 19 (AP) × 16 (TR) × 20 (CC) cm in size. The mass was heterogeneously enhanced, showing central hypodense areas suggesting necrosis. It infiltrated into segments 5 and 6 of the right liver lobe, displaced and compressed the ascending colon, and abutted the right anterolateral abdominal wall with no signs of invasion. Extensive distribution of hypodense areas featuring moderate ascites was present.

Iodine uptake of the mass was measured, and accordingly a core needle biopsy was successfully performed in the most enhanced area. The histological result defined a pleomorphic sarcoma.

Examination Protocol

Scanner	SOMATOM Definition AS+		
Scan area	Abdomen/pelvis	**Rotation time**	0.5 s
Scan mode	TBDE	**Pitch**	0.3
Scan length	473 mm	**Slice collimation**	64 × 0.6 mm
Scan direction	Cranio-caudal	**Slice width**	1.5 mm
Scan time	13 s	**Reconstruction increment**	1 mm
Tube voltage	AuSn 120 kV	**Reconstruction kernel**	D30f
Effective mAs	650 mAs	**Contrast**	350 mgL/mL
Dose modulation	CARE Dose4D™	**Volume**	100 mL + 40 mL saline
$CTDI_{vol}$	13.9 mGy	**Flow rate**	3 mL/s
DLP	682 mGy cm	**Start delay**	Bolus tracking in the descending aorta@100 HU + 6s



1 Axial (Fig. 1a) and coronal MPR (Fig. 1c) images, and cinematic VRT (Figs. 1b and 1d) images depict a bulky lobulated heterogeneously enhanced mesenteric mass in the right hypochondrial-lumbar region. Extensive distribution of hypodense areas featuring moderate ascites was present.

Comments

Pleomorphic sarcoma of the mesentery is a rare tumor entity, and the management of this is significantly different from that of a hepatocellular carcinoma. Although tests of AFP and immunohistochemistry could be helpful for differential diagnosis, identification of a target area for biopsy in such a large tumor remains challenging. TBDE CT provides the possibility of quantifying iodine uptake using *syngo*.CT DE Virtual Unenhanced. Therefore, the area with maximum iodine uptake can be measured. This reduces the chances of fetching negative tissue specimens. The reconstructed 3D images are found to be extremely helpful in enabling a clear communication and demonstration to the operating surgeons. ●

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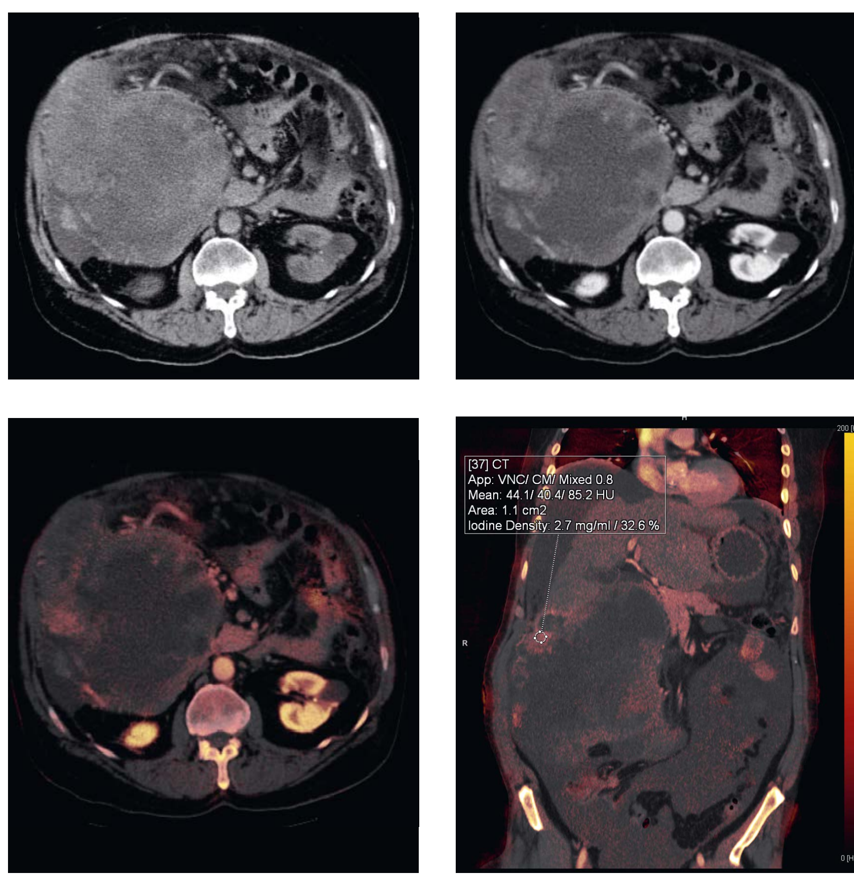


2 Axial VNC (Fig. 2a), mixed (Fig. 2b), and fused (Fig. 2c) images show the mesenteric mass with heterogeneous enhancement. A coronal view of the fused image (Fig. 2d) demonstrates the most enhanced area with a significant iodine uptake of 2.7 mg/mL.

Metastatic Pulmonary Hepatoid Carcinoma with Vascular Complications and Transplanted Kidney

By Matthias Stefan May, MD
Department of Radiology, University Hospital Erlangen, Germany

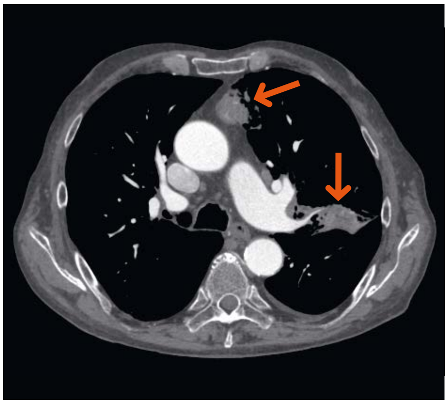
History

A 74-year-old male patient came to the hospital complaining of increasing shortness of breath. A chest radiograph showed a triangular opacity in the periphery of the left lung, possibly indicating a pulmonary embolism (PE). An abdominal ultrasound examination revealed a possible abdominal aortic aneurysm (AAA). The patient had a history of right hip replacement and chronic claudication with right lower limb pain. A decade ago, he underwent kidney transplantation, and currently had an estimated glomerular filtration rate (GFR) of 70.3 mL/min/ 1.73 m^2. TwinBeam Dual Energy (TBDE) CT imaging was performed to rule out PE and to investigate the systemic arterial circulation, using only a single bolus injection and thereby keeping the iodine charge as low as possible.

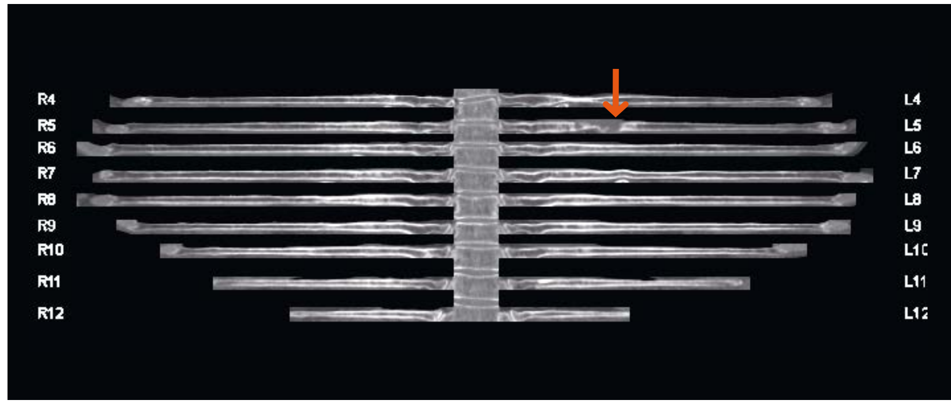
Examination Protocol

Scanner	SOMATOM go.Top		
Scan area	Whole body	Rotation time	0.33 s
Scan mode	TBDE	Pitch	0.3
Scan length	1,563.8 mm	Slice collimation	64 × 0.6 mm
Scan direction	Cranio-caudal	Slice width	0.8 mm
Scan time	44.7 s	Reconstruction increment	0.6 mm
Tube voltage	Au/Sn120 kV	Reconstruction kernel	Qr40, Bv36 and Br56 (each with ADMIRE 3)
Effective mAs	238 mAs	Contrast	350 mgL/mL
Dose modulation	CARE Dose4D™	Volume	100 mL + 30 mL saline
$CTDI_{vol}$	6.6 mGy	Flow rate	5 mL/s
DLP	1,064 mGy cm	Start delay	Aortic bolus tracking with 100 HU + 10s

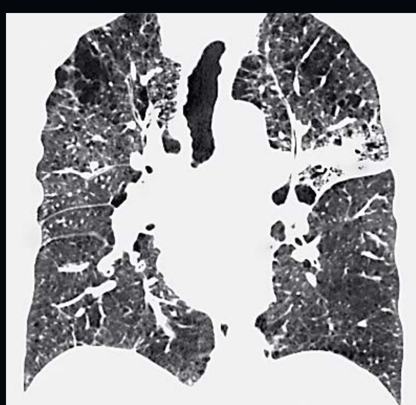
1a



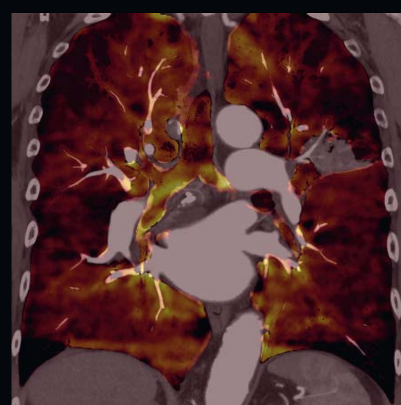
1b



1c



1d



1 Axial (Fig. 1a) and coronal (Fig. 1c) views show two consolidations in the upper left lobe in segments 2 and 3 (arrows), thickening of the surrounding septa, obstruction of the segmental bronchus 2, and enlarged lymphatic nodes in the left hilum. Lung PBV image (Fig. 1d) shows areas with defects in PBV corresponding to emphysema and distal to the obstruction of the bronchus. A rib unfolding image (Fig. 1b) easily reveals a solitary lytic bone metastasis in the left fifth rib (arrow, ribs #1–3 were incompletely covered in the scan range).

Diagnosis

CT images revealed two consolidations in the upper left lobe in segments 2 and 3, with thickening of the surrounding septa, obstruction of the segmental bronchus 2, and enlargement of the lymphatic nodes in the left hilum. These findings suggested a bronchial carcinoma with perifocal lymphangitic carcinomatosis and ipsilateral lymphatic metastases. No signs of PE were present. Histopathological workup via endobronchial biopsy resulted in a final diagnosis of pulmonary hepatoid carcinoma (G3). A solitary lytic bone metastasis in the left fifth rib was visualized. The left adrenal gland was enlarged, hyperdense and contrast enhanced, suggesting a metastasis. The infrarenal abdominal aorta was enlarged and partially thrombotic, measuring 4.8 × 4.5 cm in size, confirming an AAA. A moderate stenosis of the proximal celiac artery and a severe stenosis of the left external iliac artery, right below the well-perfused transplanted kidney in the left iliac fossa, were seen. The right superficial femoral artery was occluded in the adductor canal over a length of 5 cm, causing a delay in the blood flow of the popliteal artery via collaterals. A right prosthetic component was correctly positioned with no signs of fracture or dislocation.

Comments

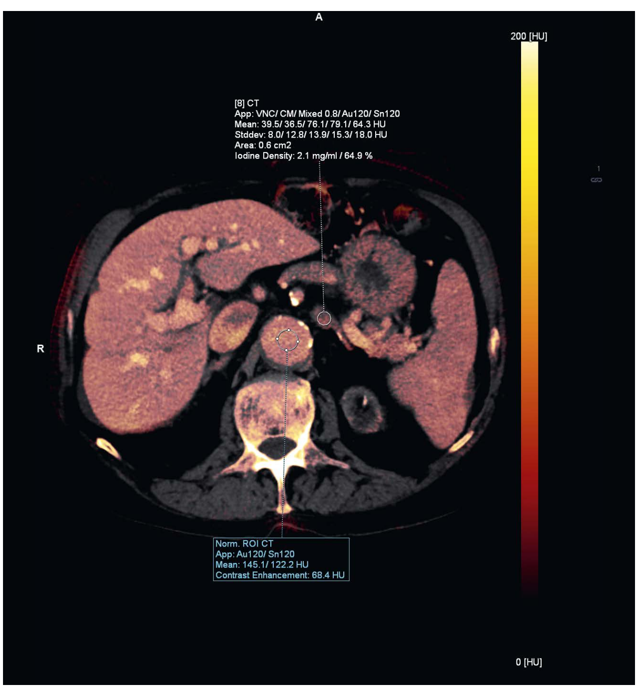
Hepatoid carcinoma is a rare extrahepatic tumor with histomorphological features similar to hepatocellular carcinoma. Pulmonary hepatoid carcinoma is extremely rare and, once detected, requires differential diagnosis from metastatic hepatocellular carcinoma. In this case, one of the challenges for the radiologist was to complete a workup of several clinical tasks with a single injection of contrast agent: Rule out a PE, evaluate lung perfusion, assess staging of bronchial carcinoma, differentiate lesion characters in the adrenal gland, evaluate an AAA as well as the left iliac kidney transplant, and determine grading of peripheral arterial disease with visualization for clinical presentation. TBDE allows the simultaneous acquisition of high and low energy spectra in a single scan. The dataset can then be processed using various DE applications. DSA-like CT angiographic images can be easily reformatted, using *syngo*.CT DE Direct Angio, to remove

2a

2b

2c

3

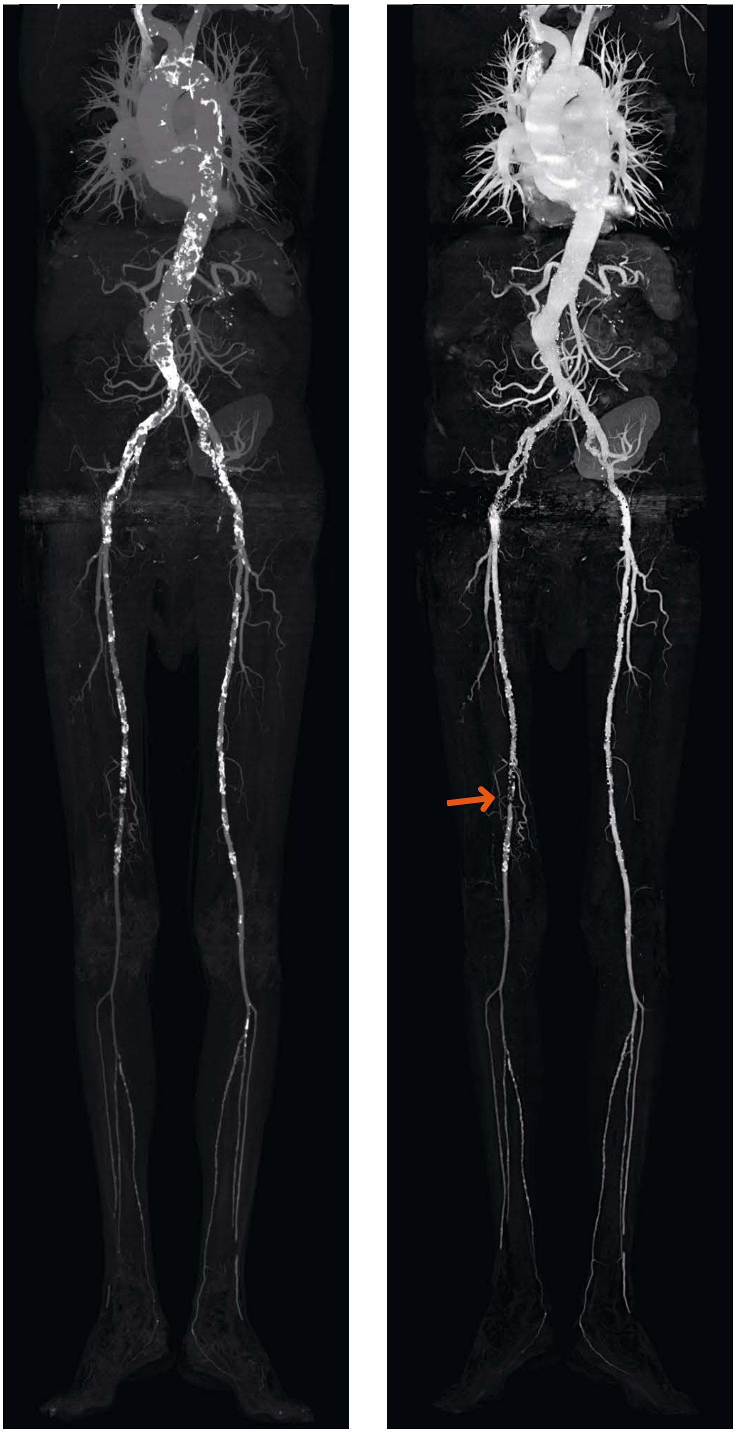


2 A cinematic VRT image (Fig. 2a) shows an AAA (dotted arrow), a moderate stenosis of the proximal celiac artery (arrow), and the well-perfused transplanted kidney. MIP images (Fig. 2b and Fig. 2c) show that a severe stenosis of the left external iliac artery, right below the renal artery of the transplanted kidney that cannot be visualized in standard reconstructions due to severe calcifications (Fig. 2b), is clearly depicted after calcium removal (Fig. 2c, arrow).

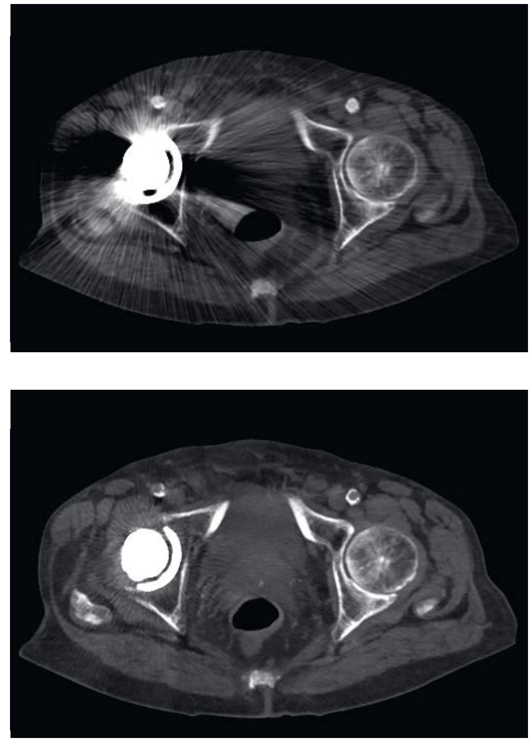
3 An axial iodine map shows an enlarged and enhanced left adrenal gland, measuring 39.5 HU in density on VNC and 76.1 HU in the portal venous phase, with an iodine uptake of 2.1 mg/mL, suggesting a metastasis.

the bony structures. Virtual noncontrast (VNC) images and iodine maps can be created using *syngo*.CT DE Virtual Unenhanced to present and quantify the iodine uptake. The image contrast can be significantly enhanced using *syngo*.CT DE Monoenergetic Plus (Mono+) at lower keV settings. The perfused blood volume (PBV) of the lungs can also be evaluated using *syngo*.CT DE Lung PBV. Additionally, the *syngo* CT Vascular application allows the generation of a curved MPR along the centerline of the abdominal aorta for an accurate measurement of its size and removal of the calcified plaques for clear visualization of the true vessel lumen as well as the severity of the stenosis. The metal artifacts caused by the hip prosthesis, which impact the view of the sur-

4a 4b



5a 5b



4 An MIP image acquired at 120 kV after bone removal (Fig. 4a) shows extensive calcified plaques in the whole body CTA. Image contrast is significantly enhanced using Mono+ at 45 keV, and the vessel lumen is clearly depicted after calcium removal (Fig. 4b). The right superficial femoral artery is occluded over a length of 5 cm (Fig. 4b, arrow), causing a delay in the blood flow in the popliteal artery via collaterals. Both images are displayed with the same window levels.

5 Axial images show that severe metal artifacts (Fig. 5a), affecting the visualization of the hip, pelvis, and the iliac arteries, are widely removed by iMAR application (Fig. 5b).

rounding anatomical structures, can be significantly reduced by iterative Metal Artifact Reduction (iMAR). All these applications help the physicians make a confident diagnosis and plan further treatment. ●

Hepatocellular Carcinoma Recurrence in a Patient with Impaired Renal Function

By Rika Iwamasa, MD*; Kenji Shinozaki, MD*; Tetsuya Minamide**
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** Department of Radiology, National Hospital Organization Kyushu Cancer Center, Fukuoka, Japan

History

A 97-year-old male patient suffering from hepatocellular carcinoma (HCC) underwent multiple sessions of transcatheter arterial chemoembolization (TACE) within the past seven years. He was referred for an assessment of an HCC recurrence due to an elevated alphafetoprotein (AFP) serum level. Regularly, it would require 600 mgL/kg for the diagnosis of HCC in our institution. Taking into consideration his impaired kidney function (eGFR 32 mL/min/1.73 m^2), only 300 mgL/kg was administered. A TwinBeam Dual Energy (TBDE) CT scan was performed.

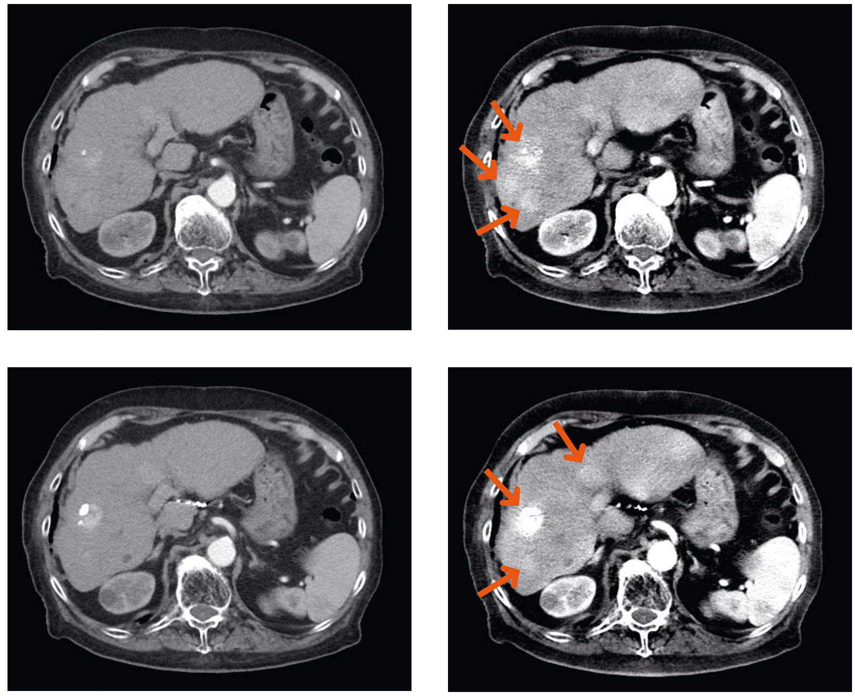
Diagnosis

TBDE CT images revealed multiple hypervascular lesions in both liver lobes. The lesions were significantly enhanced and better seen in the images displayed at 45 keV using DE Monoenergetic Plus than in the mixed images acquired at AuSn 120 kV (Fig. 1). The characteristics of the lesions suggested an HCC recurrence. In the subsequent angiography, all lesions were confirmed and another session of TACE treatment was accordingly scheduled.

Examination Protocol

Scanner	SOMATOM Definition Edge
Scan area	Abdomen
Scan mode	TwinBeam Dual Energy
Scan length	274 mm
Scan direction	Cranio-caudal
Scan time	7.64 s
Tube voltage	AuSn 120 kV
Effective mAs	559 mAs
Dose modulation	CARE Dose4D™
$CTDI_{vol}$	11.97 mGy
DLP	350.3 mGy cm
Rotation time	0.33 s
Pitch	0.3
Slice collimation	64 × 0.6 mm
Slice width	1.5 mm
Reconstruction increment	1.0 mm
Reconstruction kernel	Q30f (SAFIRE 2)
Contrast	300 mgL/mL
Volume	50 mL
Flow rate	2 mL/s
Start delay	30 s

1a 1b 1c 1d

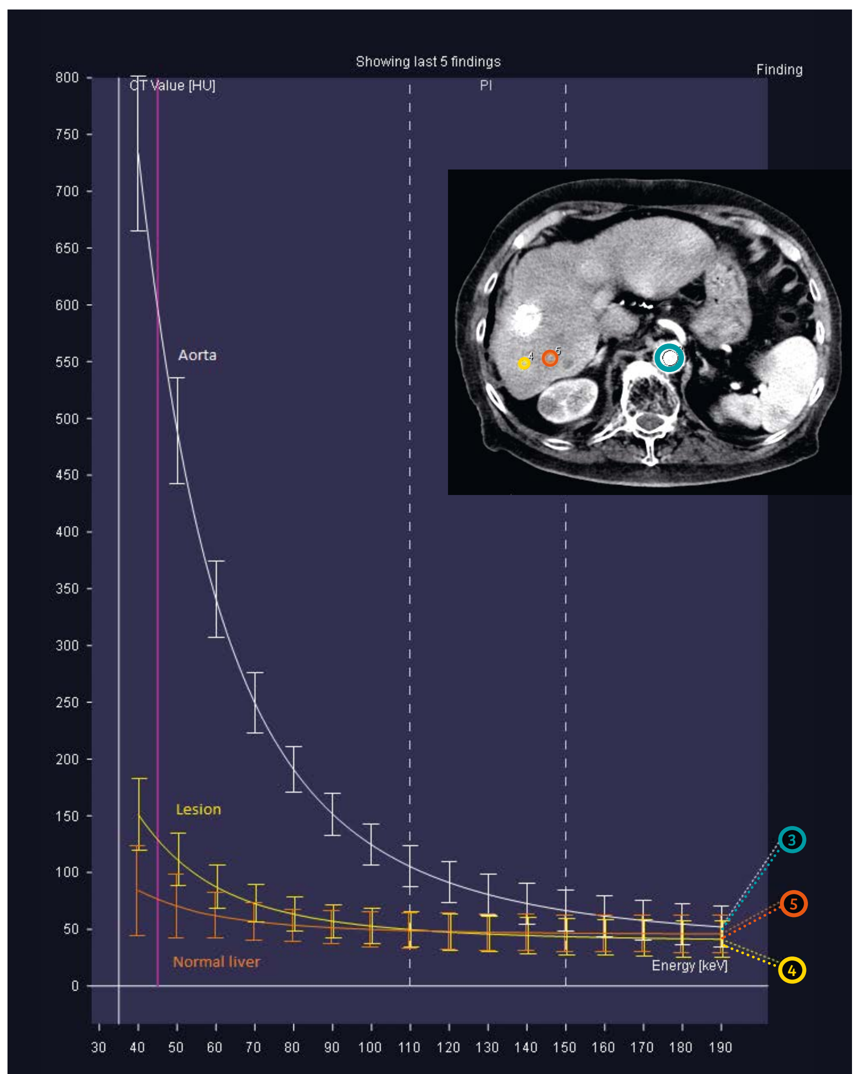


1 Axial images (5 mm) show multiple hypervascular lesions (arrows) in both liver lobes. The lesions are significantly enhanced and better seen in the images displayed at 45 keV (Figs. 1b and 1d) using DE Monoenergetic Plus than in the mixed images acquired at AuSn 120 kV (Figs. 1a and 1c). All images are displayed at window width of 350 and window center of 35.

Comments

HCC is one of the most common hypervascular lesions found in the liver. CT assessment of an HCC recurrence requires a higher contrast-to-noise ratio (CNR) and therefore an adequate amount of contrast medium administration to obtain the necessary tissue enhancement for differential diagnosis. However, the reduction of contrast medium for patients with impaired renal function must also be considered to avoid potential contrast-induced nephrotoxicity (CIN). To help manage such a conflict, advanced CT techniques have been developed, such as TBDE and *syngo*.CT DE Monoenergetic Plus. TBDE CT enables the simultaneous image acquisition at two different energy levels. Images acquired can be displayed at energy levels between 40 and 190 keV using DE Monoenergetic Plus. Image contrast can be significantly enhanced at lower energy levels and presented graphically.
In this case, although only 300 mgL/kg was administrated, the achieved lesion-to-background contrast was almost quadrupled (Fig. 2). This helps the physicians to reach a confident diagnosis and plan an adequate treatment strategy. ●

2



2 Graphical presentation shows CT attenuation in accordance with energy (keV) levels. Comparing 40 keV with 70 keV (equivalent to 120 kV acquisition), the CT value of the aorta has more than doubled and the lesion-to-background (normal liver tissue) contrast has almost quadrupled.

An Incidental Finding of Hepatocellular Carcinoma

By Parang Sanghavi, MD; Bhavin Govindji Jankharia, MD
Jankharia Imaging Centre, Mumbai, India

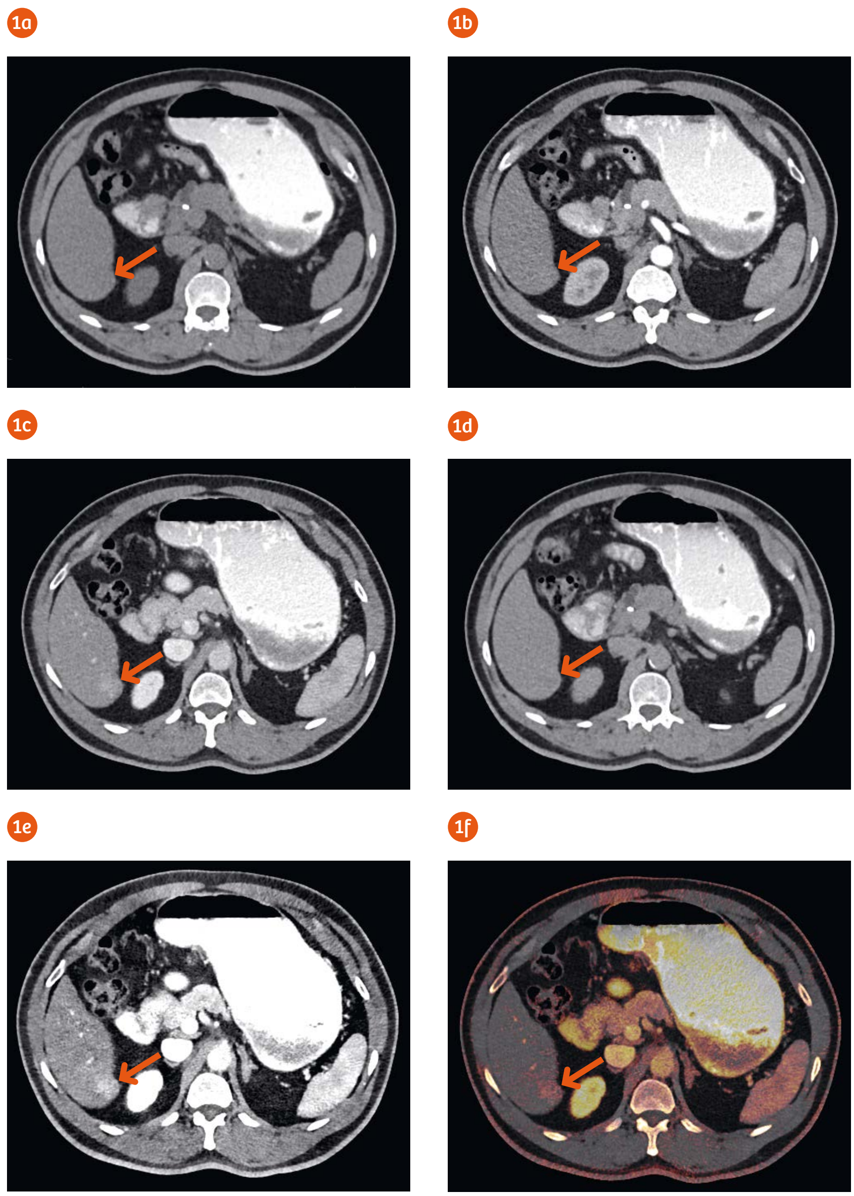
History

A 61-year-old male patient, being treated for diabetes and hypertension, came to the hospital for a routine ultrasonography (USG) examination. A liver lesion was detected and a mild increase in hepatic stiffness was shown. A triple phase TwinBeam Dual Energy (TBDE) CT scan was requested for further evaluation.

Diagnosis

Noncontrast CT images showed a mild bulge of the Glisson's capsule in segment 6 of the right hepatic lobe (Fig. 1a). Heterogeneous enhancement, not visualized in the early arterial phase (Fig. 1b), was barely perceptible in the late arterial / portal venous phase, suggesting a solitary subcapsular focal lesion (Fig. 1c), measuring 2.2 × 1.5 cm in size. The contrast was washed-out in the delayed phase (Fig. 1d). DE Monoenergetic images displayed at 50 keV (Fig. 1e) showed significant improvement in lesion visibility and contrast-to-noise ratio (CNR). DE iodine maps (Fig. 1f) revealed a lesion iodine uptake of 2.2 mg/mL (Fig. 2). Mild diffuse nodularity was shown in the hepatic parenchyma, corresponding to chronic liver disease.

Hepatocellular carcinoma (HCC) with liver cirrhosis was suspected, and subsequently confirmed by MRI.

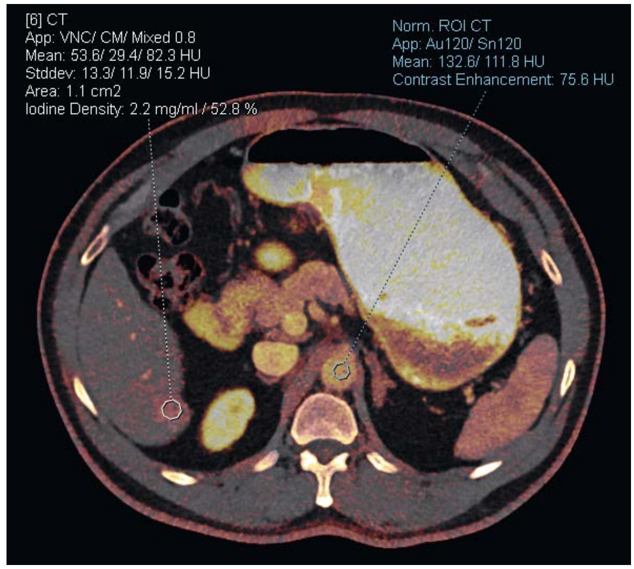


1 Axial images acquired in noncontrast (Fig. 1a), arterial (Fig. 1b), portal venous (Fig. 1c), and delayed (Fig. d) phases show a mild bulge of the Glisson's capsule in segment 6 (arrows), barely perceptible as an enhancing focal lesion. A DE Monoenergetic image displayed at 50 keV (Fig. 1e) and iodine mapping (Fig. 1f) demonstrate significantly improved conspicuity of contrast enhancement.

Comments

HCC is the most common primary malignancy of the liver and is strongly associated with cirrhosis. Since enhancement patterns are the key to correct CT assessment of HCCs, a higher contrast-to-noise ratio (CNR) is required. TBDE enables the simultaneous image acquisition at two different energy levels to decompose materials and extract iodine. Images displayed at a lower energy level, e.g., 50 keV, using *syngo*.CT DE Monoenergetic Plus, have a significantly enhanced contrast. Iodine maps as well as virtual noncontrast (VNC) images can be generated and the iodine uptake can be quantified, using *syngo*.CT DE Virtual Unenhanced. These lead to improved conspicuity of contrast enhancement and lesion characterization. These images may also serve as a baseline in follow-up studies for treatment response assessment (1,2,3). ●

2



2 Axial iodine map shows an enhancing focal lesion in segment 6, with an increased density of 29.4 HU and an iodine uptake of 2.2 mg/mL.

References

[1] Lee SH, Lee JM, Kim KW, et al. Dual-energy computed tomography to assess tumor response to hepatic radiofrequency ablation: potential diagnostic value of virtual noncontrast images and iodine maps. Invest Radiol 2011; 46(2):77–84.

[2] Mukta D. Agrawal, MBBS, MD, Daniella F. Pinho, MD, Naveen M. Kulkarni et al. Oncologic Applications of Dual Energy CT in the Abdomen RadioGraphics 2014; 34:589–612.

[3] Carlo Nicola De Cecco1, Anna Darnell2, Marco Rengo1, Giuseppe Muscogiuri et al. Dual-Energy CT: Oncologic Applications AJR 2012; 199:S98–S105

Examination Protocol

Scanner	SOMATOM Definition Edge		
Scan area	Abdomen and pelvis	Rotation time	0.33 s
Scan mode	TwinBeam Dual Energy	Pitch	0.45
Scan length	318 mm	Slice collimation	64 × 0.6 mm
Scan direction	Caudo-cranial	Slice width	1.5 mm
Scan time	6 s	Reconstruction increment	1.0 mm
Tube voltage	AuSn 120 kV	Reconstruction kernel	I30f
Effective mAs	248 mAs	Contrast	350 mgL/mL
Dose modulation	CARE Dose4D™	Volume	70 mL + 50 mL saline
$CTDI_{vol}$	5.33 mGy	Flow rate	3 mL/s
DLP	140.4 mGy cm	Start delay	Bolus tracking in the descending aorta with a threshold of 100 HU and an additional delay of 6 s

Giant Cell Tumor in Tendon Sheath of the Right Ankle

By Xu Zhang, RT*; Kun Li, MD*; Chengde Liao, MD*; Yingying Ding, MD*; Xi Zhao, MD**
*Department of Radiology, Yunnan Cancer Hospital, The Third Affiliated Hospital of Kunming Medical University, Yunnan, P. R. China, **Siemens Healthineers, P. R. China

History

A 56-year-old female patient presented with a swollen and painful right ankle. She reported a trauma to this ankle 20 years ago. She had noticed a growing soft-tissue mass on the right ankle for the past four years. The mass was associated with swelling and pain that became aggravated while walking. In the past two years, surgical excision had been performed twice to remove the mass due to its recurrence and accompanying severe pain. The histological result was not available at admission. A Dual Energy CT (DECT) examination was requested for further evaluation.

Diagnosis

CT images showed a well-defined, unevenly enhanced soft-tissue mass enveloping the right ankle. The largest portion of the mass was over the anterolateral aspect, measuring 4.5 × 5.8 cm in size. The mass was wrapped with medial and lateral malleolar branches as well as the dorsalis pedis artery involving the right peroneal artery, as well as the posterior and anterior tibial arteries. The perforating veins between the deep and superficial veins were noticeably enlarged (Figs. 1 and 2). Pronounced cortical destructions of the talus, the navicular, and the upper calcaneus were also seen (Fig. 3). The patient underwent subsequent ultrasound-guided percutaneous biopsy. The histopathological result revealed a giant cell tumor in the tendon sheath (GCTTS). A surgical excision of the mass was planned.

Examination Protocol

Scanner	**SOMATOM Force**		
Scan area	Lower extremities	**Rotation time**	0.5 s
Scan mode	Dual Energy	**Pitch**	0.7
Scan length	691 mm	**Slice collimation**	128 × 0.6 mm
Scan direction	Caudo-cranial	**Slice width**	1.0 mm
Scan time	12.9 s	**Reconstruction increment**	0.7 mm
Tube voltage	80 / Sn150 kV	**Reconstruction kernel**	Qr40, ADMIRE 3
Effective mAs	62 / 37 mAs	**Contrast**	370 mgL/mL
Dose modulation	CARE Dose4D™	**Volume**	60 mL at 70% + 38 mL + 30 mL saline
$CTDI_{vol}$	2.44 mGy	**Flow rate**	5 mL/s + 5 mL/s + 4.5 mL/s
DLP	177.2 mGy cm	**Start delay**	Bolus tracking in the popliteal artery at 100 HU and an additional delay of 8 s

1

1 Cinematic rendering images show the soft tissue mass enveloping the right ankle and the relevant vasculature of the right lower extremity. The blood supply of the mass involves multiple branches of the right peroneal artery, as well as the posterior and anterior tibial arteries. The enlarged perforating veins between the deep and superficial veins are also clearly shown. The original CT images were displayed at 40 keV.

Comments

GCTTS is a benign lesion of uncertain etiology. However, it does have a high incidence of recurrence after excision.[1,2] The foot and ankle are rare sites of involvement. One of the most important clinical features is that the symptoms of GCTTS are non-specific, making the diagnosis difficult. Treatments consist of careful local excision, particularly microscopic excision, and postoperative radiotherapy.[2] It is imperative to know the anatomy of the tumor, so that the surgical incision can be planned accordingly, allowing the surgeons to reach its extensions.[3] Although MRI has been helpful in the anatomical assessment of soft-tissue tumors and may be incorporated into the preoperative workup,[4] there are patients who have contraindications to MRI or for whom MRI is not available. Our experience with DECT in the evaluation of this case was promising. DECT applies a special filter technique (Tin Filter), Selective Photon Shield (SPS II), which enables significant separation of energy spectra at 80 and 150 kV settings. The attenuation measurements acquired at these two kV settings are used to display images at different keV levels using *syngo*.CT DE Monoenergetic Plus. Compared with conventional CT images acquired at 120 kV, image contrast at 40 keV is significantly enhanced, allowing a clearer and easier visualization of the mass extension (Fig. 5). The same image data can also be used to generate iodine/VNC-fused images using *syngo*.CT DE Virtual Unenhanced for better differentiation of enhanced mass tissue and the non-invaded tendons (Fig. 4). The bone structures can be removed using *syngo*.CT DE Direct Angio to show non-obscured vasculature. All these applications are performed in an automated workflow. To achieve a dose-neutral DECT examination, other advanced techniques such as CARE Dose4D™ (real-time anatomic exposure control) and ADMIRE (advanced modeled iterative reconstruction) are also available. In this case, an effective dose of only 0.14 mSv was applied to the patient.

2 Cinematic rendering images (Figs. 2a and 2b), using different presets, demonstrate different anatomical views of the right lower extremity. An MIP image (Fig. 2c) generated by using DE Direct Angio shows the vasculature not obscured by bones. The original CT images were displayed at 40 keV.

3 Sagittal (Fig. 3a), oblique (Fig. 3b), and axial (Fig. 3c) MPR images show cortical destructions of the talus, the navicular, and the upper calcaneus.

References

[1] Findlin J. Lascola NK, Grone TW. Giant cell tumor of the flexor hallucis longus tendon sheath: a case study. J Am Podiatr Med Assoc. 2011; 101(2):187-189.

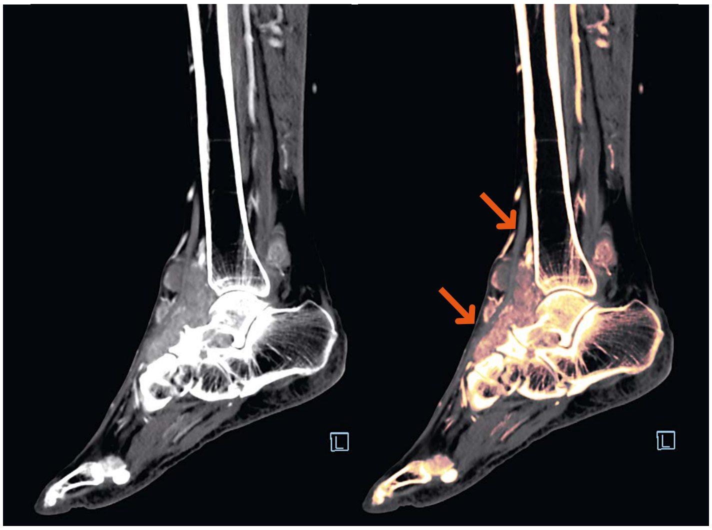
[2] Sun C, Sheng W, Yu H, et al. Giant cell tumor of the tendon sheath: A rare case in the left knee of a 15-year-old boy. Oncology Letters. 2012;(3):718-720.

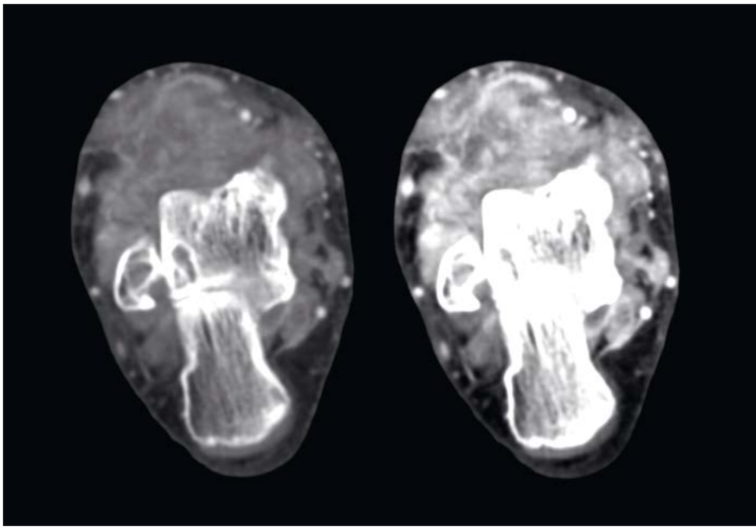
[3] Vargaonkar G, et al. Giant Cell Tumor of the Tendon Sheath around the Foot and Ankle, a Report of Three Cases and a Literature Review. J Am Podiatr Med Assoc. 2015;105(3):249-254.

[4] Demouy EH, Kaneko K, Bear HM, et al.: Giant cell tumor of the plantar tendon sheath: role of MR imaging in diagnosis. Case report. Clin Imaging. 1993;17(2):153-155.

In clinical practice, the use of ADMIRE 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.

The outcomes by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other customers will achieve the same results.





4 Sagittal view of an iodine/VNC-fused image (Fig. 4b) shows better differentiation of the enhanced mass tissue from the extensor digitorum longus tendon (arrows) compared to a standard CT image (Fig. 4a).

5 An axial image displayed at 40 keV (Fig. 5b) shows much better contrast and clearer mass extension compared to a standard CT image (Fig. 5a).

Coronary CTA Interpretation Workshop: Learn from the Experts

Siemens Healthineers has a strong tradition of supporting continuing education, and 2019 will see this commitment continue. The sessions include a cardiac workshop at University Hospital Erlangen in Germany. Professor Stephan Achenbach, MD (Chairman of the Department of Cardiology) and his team will teach participants about interpreting coronary CTAs and how to recognize typical as well as more complex findings.

Over two days, participants will work toward Level II certification using *syngo*.via image interpretation workstations to evaluate 50 coronary CT angiography scans. They will range from easy introductory cases to more advanced cases with difficult diagnoses and typical pitfalls. Invasive coronary angiography correlation will be available for each CT angiography case. Scientific lectures will round off the event.

This workshop is ideal for cardiologists and radiologists who have a basic grasp of cardiac computed tomography and want to improve their interpretation skills. Past attendees have praised the direct interaction with Professor Achenbach and his team, as well as the opportunity to clarify questions in person. The feedback from participants is extremely positive: "Great course", "Very satisfied with content and presentation", "Thank you so much for such an informative and organized course", "Looking forward to future courses".

The next opportunity to engage with experts and deepen your knowledge with professional guidance is scheduled for November 21–22, 2019.

For further information, visit
siemens.com/SOMATOMEducate

The cardiac workshop at University Hospital Erlangen in Germany is ideal for cardiologists and radiologists to improve their interpretation skills with professional guidance.

Upcoming Events & Congresses 2018/2019

Short Description	Date	Location	Title	Contact
Radiological Society of North America	November 25–30, 2018	Chicago, USA	RSNA	www.rsna.org
Society of Cardiovascular Computed Tomography	January 24–25, 2019	Dublin, Ireland	SCCT	www.scct.org
Arab Health	January 28–31, 2019	Dubai, UAE	Arab Health	www.arabhealthonline.com
European Society of Radiology	February 27–March 3, 2019	Vienna, Austria	ECR	www.myesr.org
European Conference on Interventional Oncology	April 8–11, 2019	Amsterdam, The Netherlands	ECIO	www.ecio.org
International Technical Exhibition of Medical Imaging	April 12–14, 2019	Yokohama, Japan	ITEM	www.j-rc.org
European Society for Radiotherapy & Oncology	April 26–30, 2019	Milan, Italy	ESTRO	www.estro.org
European Society of Thoracic Imaging	May 9–11, 2019	Paris, France	ESTI	www.myesti.org
European Society of Paediatric Radiology	May 14–18, 2019	Helsinki, Finland	ESPR	www.espr.org
European Society of Emergency Radiology	May 16–17, 2019	Seville, Spain	ESER	www.eser-society.org
German Congress of Radiology	May 29–June 1, 2019	Leipzig, Germany	DRK	www.roentgenkongress.de
American Society of Clinical Oncology	May 31–June 4, 2019	Chicago, USA	ASCO	www.am.asco.org
European Society of Gastrointestinal and Abdominal Radiology	June 5–8, 2019	Rome, Italy	ESGAR	www.esgar.org
Jahrestagung der Deutschen Gesellschaft für Radioonkologie	June 13–16, 2019	Münster, Germany	DEGRO	www.degro.org
European Society of Oncologic Imaging	June 19–22, 2019	Dubrovnik, Croatia	ESOI OIC. 9	www.esoi-society.org
Society of Cardiovascular Computed Tomography	July 11–14, 2019	Baltimore, USA	SCCT	www.scct.org
American Association of Physicists in Medicine	July 14–18, 2019	San Antonio, USA	AAPM	www.aapm.org
European Society of Cardiology	August 31–September 4, 2019	Paris, France	ESC	www.escardio.org
The American Society of Emergency Radiology	September 11–14, 2019	Scottsdale, USA	ASER	www.aser.org
European Society for Medical Oncology	September 27–October 1, 2019	Barcelona, Spain	ESMO	www.esmo.org
French Days of Radiology	October 11–14, 2019	Paris, France	JFR	http://jfr.radiologie.fr/
Radiological Society of North America	December 1–6, 2019	Chicago, USA	RSNA	www.rsna.org

Clinical Workshops 2019

As a cooperation partner to many renowned hospitals, Siemens Healthcare offers continuing CT training programs. In a wide range of workshops, clinical experts share latest experiences and options in clinical CT imaging.

Workshop Title/ Special Interest	Date	Location	Course Language	Organizer – Course Director	Link
Hands-on at the ESGAR Workshop / Colonography	April 10–12, 2019	Paris, France	English	ESGAR **Local Organiser:** Prof. Olivier Lucidarme, MD **Scientific Coordinator:** Prof. Philippe Lefere, MD	www.esgar.org
Workshop on Dual Energy	May 16–17, 2019	Forchheim, Germany	English	Siemens Healthineers – Prof. Ralf Bauer, MD	siemens.com/ SOMATOMeducate
Hands-on at the ESGAR Congress / Colonography	June 5–8, 2019	Rome, Italy	English	ESGAR **Scientific Coordinator:** Marc Zins, MD	www.esgar.org
Oncology Imaging Course	June 19–22, 2019	Dubrovnic, Croatia	English	Prof. Regina Beets-Tan, MD Prof. Christian Herold, MD Prof. Dr. Dr.h.c. Hedvig Hricak, MD Prof. Andrea Laghi, MD Daniele Regge, MD Prof. Dr. Dr.h.c. Maximilian F. Reiser, MD	www.oncoic.org
Hands-on at the ESC congress	Aug 31– Sept 4, 2019	Paris, France	English	Siemens Healthineers	siemens.com/ESC
Hands-on at the ESGAR Workshop / Colonography	October 9–11, 2019	Dublin, Ireland	English	ESGAR **Local Organiser**: Prof. Martina Morrin, MD **Scientific Coordinator:** Dr. Andrew Plumb	www.esgar.org
Workshop for Physicists	October 22–23, 2019	Forchheim, Germany	English	Siemens Healthineers	siemens.com/ SOMATOMeducate
Coronary CTA Interpretation Workshop	November, 21-22, 2019	Erlangen, Germany	English	Siemens Healthineers Prof. Stephan Achenbach, MD	siemens.com/ SOMATOMeducate

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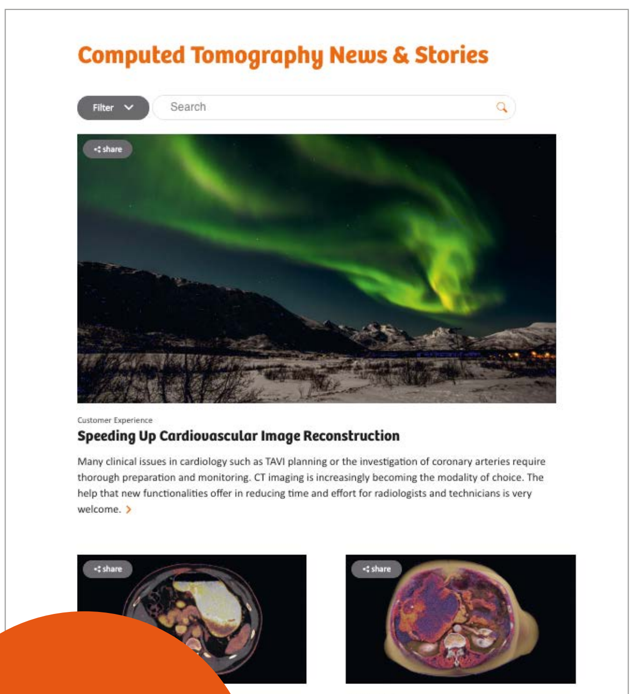

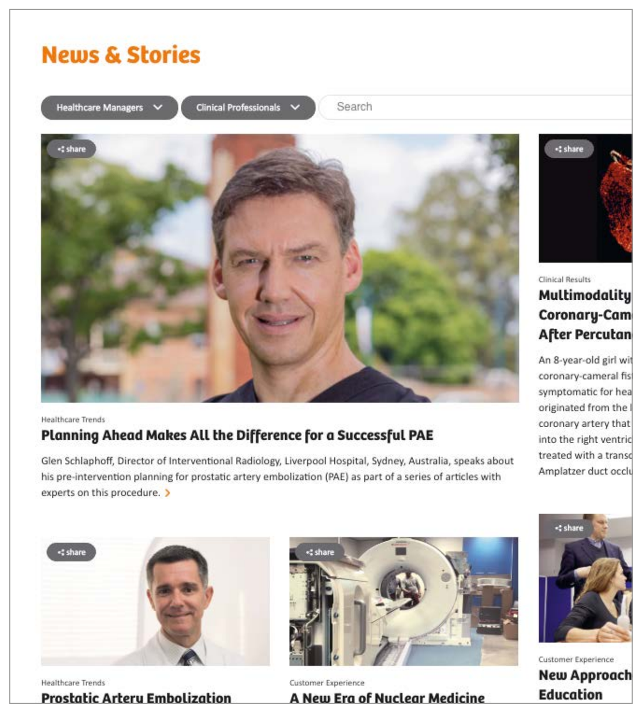

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