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TOSHIBA

Leading Innovation

VISIONS

FEBRUARY 2014

COMPUTED TOMOGRAPHY

Superiority of Lung Subtraction Above Dual Energy

X-RAY

Spot Fluoro - Reducing Dose in Interventional Procedures

ULTRASOUND

Creating New Standards in Ultrasound Cardiology

MAGNETIC RESONANCE

Vantage ELAN Perfectly Combines Performance and Affordability

23

Imprint

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Dear reader,

I grew up following the science fiction TV series, 'Star Trek'. The original series was broadcast in the Netherlands between 1966 and 1969 and at that time, I was already intrigued by the foresight of the series' Writer and Producer, Gene Roddenberry, and his team, particularly on technology and medical science.

Devices in the series, such as The Communicator, Hypospray and Medical Tricorder, were presented as everyday utilitarian objects. Central characters, such as Captain James T. Kirk, used communicators to talk across galaxies with the starship, 'The USS Enterprise'. And the ship's Chief Medical Officer, Dr. McCoy, collected physiological information about patients and diagnosed diseases in just a couple of seconds. Further extensive clinical diagnoses were possible on board the ship using even more futuristic and astonishing systems and technologies. 'Completely logical', I imagine Science Officer, Spock, would say.

Now, almost 50 years later, we consider mobile phones as an essential part of our lives, ourselves, and sometimes, even our personality. While they are true commodities, promising new concepts, technologies and products are emerging on the healthcare horizon. For example, Google Glass[1] that enables live transmission of surgeries to medical colleagues and students. Or the Google Smart Contact Lens[2] that can help people with diabetes control blood sugar level by measuring glucose levels in their tears second-by-second. Last but not least, the Scanadu Scout[3]. A scanner packed with sensors that enable anyone to conduct sophisticated physical examinations in an instance. A first step in the realization of Dr. McCoy's Medical Tricorder? These are all fascinating developments that might have immediate impact on medicine, or might become important in the very near future.

We, at Toshiba, follow all kinds of medical developments with great interest, but nevertheless, prefer to focus on continuously creating leading innovations in our field of expertise: medical imaging and treatment. Every year, we file thousands of patents, making innovation a key part of Toshiba's fabric. And with each new product and technology that we develop, we keep in mind that the best patient treatment starts with a fast, safe and accurate examination to enable reliable diagnosis.

Our aim and dedication is to provide you with amazing, unprecedented, state-of-the-art imaging and treatment products, systems and technologies that you never thought to be true. Or, as Dr. McCoy would say: "It is medical imaging, Jim, but not as we know it".

Kind regards,

Jack Hoogendoorn
Sr. Manager Marketing Communications
Toshiba Medical Systems Europe BV

[1] http://tinyurl.com/nfdfuwc
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[3] http://www.scanadu.com

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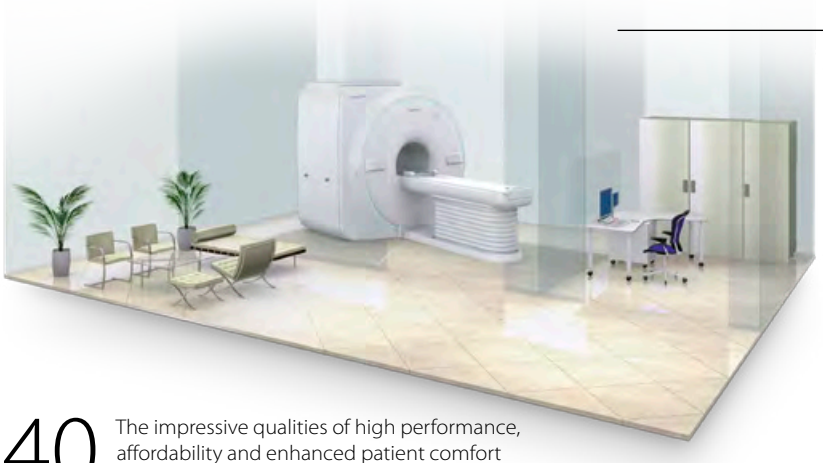

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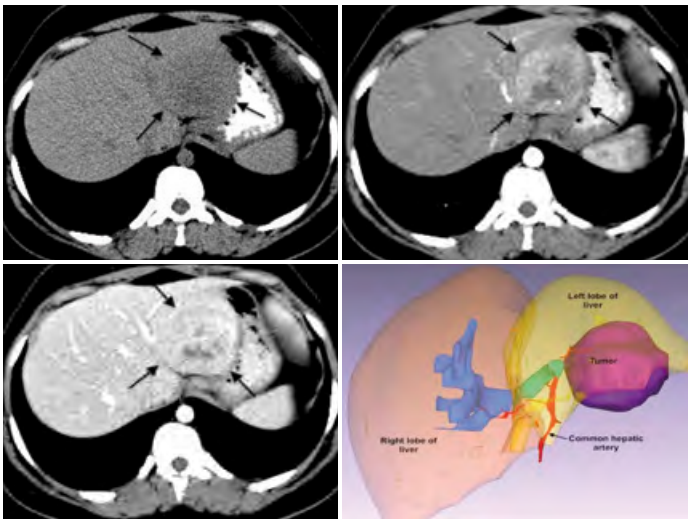

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NEWS

Edinburgh: Transforming Global Healthcare

Edinburgh is home to world-leading medical researchers who work in partnership with the NHS and the private sector. This close cooperation helps to accelerate medical discoveries and transform them into treatments for patients.

Toshiba is featured in a promotional clip from the inspiring captial of Scotland. Have a look and pay special attention to the frames from 1:23m-1:44m where Dr. Ken Sutherland explains about Toshiba's activities in Edinburgh.

http://tinyurl.com/punkwhp

Vanitas/Self-portrait 35, 2014 (exerpt)
Material: sealing wax, wood
Dimensions: 140x85x80

Photography: Erik en Petra Hesmerg

Free Admission

with the voucher on the back of this magazine!

The Bone Exhibition

Self-portrait forms a red thread throughout the work of Caspar Berger. He became famous for self-portraits made from direct casts of his body, previously taken from the skin. This time the award-winning Dutch artist made an exact copy of his own skeleton using a Toshiba Aquilion CT scanner and 3D-print technology, which he then incorporated into a wide variety of creative interpretations. The result is a lifelike 'interior' portrait of the artist, although none of the individual works features his fully intact skeleton. Curious how this is done? Have a look at: http://tinyurl.com/pk9rbhv

In 'Bone', Berger explored the concept of humans in fossil form. The hard parts of his body were effectively 'preserved' in stone objects. The piece entitled 'Do Not be Afraid of Becoming a Bench/Self-Portrait 28' contains casts of all the bones of his skeleton. The exhibition 'Bone' can be seen at museum Beelden aan Zee, the Netherlands from February till June 2014.

www.casparberger.nl

www.beeldenaanzee.nl/en

The page on the right is part of the VISIONS Photo Page Series reflecting an eye for the beauty of our planet, the environment and the direct surroundings where Toshiba's systems are installed by Toshiba and its customers. Not the actual imaging products but photos of sceneries, cities, countries or other cultural aspects are highlighted on this photo page. The Photo Page is based upon an idea of Prof. Edwin van Beek.
Every reader of VISIONS can participate and get their picture published. The submitted content should include: high resolution (300dpi) image, photo of the hospital and a brief text, name of photographer and Toshiba system(s) installed. The complete result is shown on the opposite page.

Send your pictures and texts to: jhoogendoorn@tmse.nl, Subject: Photo Page

Nelspruit Medi-Clinic *offers a magnificent panoramic view of the Drakensberg Mountain range in South Africa, and is conveniently situated within easy reach of major arterial traffic routes. The hospital services a community that spreads as far as Belfast to Hoedspruit to Swaziland to Maputo. The imaging facilities of Drs Van Rensburg and Partners provide a full radiological service to the patients and doctors of Nelspruit Medi-Clinic, offering all diagnostic modalities including a Toshiba Aquilion64 CT scanner and Toshiba Zexira/FPD medical diagnostic imaging system.*

Text sources: www.mediclinic.co.za & http://vrprad.co.za/nelspruit-medi-clinic.html
Photography: Jaco Terlouw

Kruger National Park is one of the largest game reserves in Africa. It covers an area of 19,633 km^2 in the provinces of Limpopo and Mpumalanga in northeastern South Africa, and extends 360 km from north to south and 65 km from east to west. Areas of the park were first protected by the government of the South African Republic in 1898, and it became South Africa's first national park in 1926.

Text Source: Wikipedia – Photography: Jaco Terlouw

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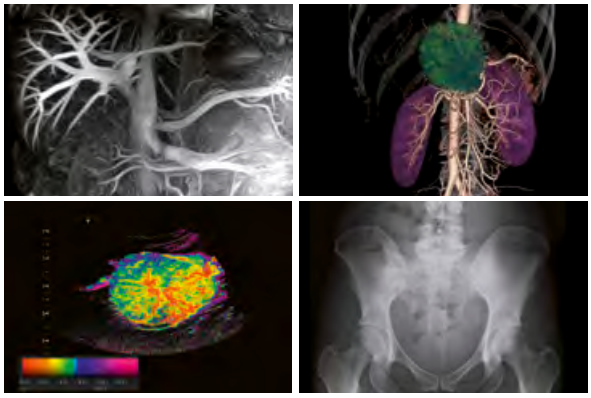
MADE FOR LIFE.



Our lives and social environment are subject to constant change and create ever-increasing needs and high demand for better medical solutions. We at Toshiba aim to maximize the quality, safety, and efficiency of medical care, supporting clinical practice with reliable quality products and innovative, cutting-edge technologies.

The high image resolution and superior operability of our medical systems creates new clinical value. While our advanced applications, supported by highly reliable technologies, open the door to the next stage of medical care.

We will continue to provide a wide variety of leading-edge solutions for the benefit of all people around the world, and seek to further development in the field of healthcare following our basic commitments: "Improving the quality of life", "Lifelong commitment to innovation", and "Achieving lifetime partnerships".

Toshiba: Made for Life!

Made for Life™

TOSHIBA eco style

PRESIDENT'S MESSAGE

"We always keep our customers first."

Toshiba's primary focus for FY2013 was to better understand our customer and the needs of their business in medical imaging – we always want to keep the customers first.

In our CT business, we reached a very significant milestone with the manufacture of our 30,000th CT system in November 2013. We have continuously offered leading, innovative products based on the clinical needs of our customers since our first CT introduction. We believe that lowering CT dose and improving workflow are not choices that clinicians should have to make, so Toshiba CT is putting customers first by providing the industry's best solutions to solve these challenges. We introduced Toshiba's most advanced dose reduction technology, AIDR 3D, which enables our customers to achieve the best clinical results at the lowest dose. More recently we have introduced the suite of Adaptive Diagnostic CT technology, which makes complex examinations easier while simultaneously improving diagnostic accuracy and reproducibility to solve clinical challenges faced daily in routine practice.

In our X-Ray business, we had the worldwide introduction of the DTS (Dose Tracking System) at RSNA 2013. This technology provides a real-time display of the cumulative skin dose distribution during interventional procedures. The push for developing this technology came from the strong desire from the doctors to be able to monitor and minimize patient radiation which had risen sharply in recent years during interventions. Our team listened to this VOC (Voice of Customers) from around the world and successfully developed this system – understanding our customers' business needs to protect their patients.

In the MRI business unit, we launched Vantage Elan™, which is providing excellent image quality, while achieving ease-of-use, in a quiet environment, and with a very compact footprint. The operation of Vantage Elan is simple for any level of user which means better images for every customer while increasing operational efficiency. Vantage Elan requires only 23m^2, and 5 working days for the complete installation after system delivery which means real savings for the customer. Vantage Elan is the realization of the MRI team's design goal of "No Compromises in Image Quality", in spite of its compactness. I am confident that this system will become the new standard of the next generation of MRI systems.

Our Ultrasound team launched a new technology called SMI (Superb Micro vascular Imaging). This new algorithm isolates and removes clutter while preserving the underlying hemodynamic flow information. This technology allows you to see the flow information that is behind the clutter and visualize extremely low velocity flows that are typically obscured with conventional Color Doppler. See the unseen – A giant step towards achieving our goal of "Picture Perfect Ultrasound" starts from here.

Finally, last but not least, as of October 1st, healthcare has become one of the three business pillars of the Toshiba Corporation, and TMSC will be the core member of the new Healthcare Systems & Services Group. We will be working closely with the new established Healthcare Business Development Division in Toshiba Corporation. The mission of the Healthcare Group is to extend the scope of business from medical diagnostics to new healthcare related business, including disease prevention and patient care. With this initiative, and carefully expanding our businesses, we are continuing in our corporate philosophy to keep the customers and more importantly their patients first.

Satoshi Tsunakawa
President and Chief Executive Officer
Toshiba Medical Systems Corporation

Minimize. Visualize.

By focusing on low dose, high-quality imaging technologies for accurate diagnosis and treatment, Toshiba continues to improve the quality of life for all people.

Satellite Symposia MR/CT

Adaptive Diagnostics - Solving Clinical Challenges

Friday, March 7, 12:30 - 13:30 hrs, Room B

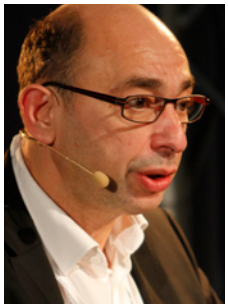
Moderator: Prof. Dr. D. Hahn, Berlin, Germany

Speaker	Time Slot	Title
Prof. Dr. F. Barkhof, Amsterdam, The Netherlands	12.30 - 12.50	Latest generation 3T MRI first experience in Neuroradiology [1)]
Prof. A. Blum, Nancy, France	12.50 - 13.10	A new reconstruction algorithm: Single Energy Metal Artefacts Reduction (SEMAR), applied for evaluation of hip protheses [2)]
Prof. M. Prokop, Nijmegen, The Netherlands	13.10 - 13.30	Lung subtraction versus Dual Energy [3)]

Prof. F. Barkhof

1) Prof. F. Barkhof

A 3T MRI system brings major advantages in neuroradiology compared to the 1.5T systems. Our initial experience with a latest generation 3T system, the Vantage Titan, indicates that the system provides increased patient comfort while offering significant quality and diagnostic benefits for several clinical applications. In this presentation we will discuss our initial clinical experience with the Vantage Titan 3T system, including clinical cases of time-of-flight MRA for evaluation of the vasculature, isotropic 3D FLAIR in the assessment of glioma and multiple sclerosis. Moreover, flow-spoiled black blood (FSBB), a proprietary Toshiba technique, is explored for the evaluation of microvasculature (lenticulostriate arteries) in aging and dementia.



Prof. A. Blum

2) Prof. A. Blum

Total Hip Arthroplasty (THA) is frequently performed for the treatment of advanced degenerative joint disease of the hip. Complication rates are low but the great number of hip prosthesis implanted renders radiologists prone to be confronted to post surgical peri prosthetic complications.

Radiography remains the first step to assess a THA but CT-scans, MRI and sonography are now complementary tools that might be useful for the etiological diagnosis of a painful THA. Common indications for CT of THA are a painful hip prosthesis with normal radiographic findings, the assessment of osteolysis before surgical revision, the evaluation of soft tissues complications and the measurement of acetabular cup placement.

Classic CT-scan is hampered by metal artifacts and is responsible for high radiation dose to the patient. Soft tissues anomalies are hardly seen with classic CT-scan. When optimized to reduce metal artifacts using suitable acquisition techniques and new algorithms, CT-scan is the most polyvalent technique to assess the components of the prosthesis, the cement and the bone interface, the bone stock and the soft tissues. These new algorithms: iterative reconstruction (AIDR 3D) and metal artifact reduction (SEMAR) software improve the image quality while reducing the dose. The objective of this presentation is to show how to improve prosthesis evaluation with CT scan.

Prof M. Prokop

3) Prof. M. Prokop

Pulmonary embolism with CT is a great challenge because small thrombi can easily be missed (many small arteries), differentiation partial volume making real embolus difficult. Furthermore, reduced lung perfusion almost invisible on standard CT.

In this lecture, we will look into Dual Energy and Subtraction imaging techniques to detect perfusion defects, to help localize small emboli, and to increase a prognostic value. Both advantages and down sides of each method will be analysed and presented.

Satellite Symposia ULTRASOUND

Expanding Clinical Boundries in Ultrasound

Saturday, March 8, 2014, 12.30 - 13.30 hrs, Room E1

Moderator: Prof. V. Mitkov, Russia

Speaker	Time Slot	Title
Dr. T. Fischer, Berlin, Germany	12.30 - 12.50	Genitourinary Ultrasound: Advanced Diagnostics in Prostate Cancer and Scrotal Lesions [1)]
Prof. A. Lim, London, United Kingdom	12.50 - 13.10	Abdominal and high-frequency Ultrasound imaging: Latest technologies for improved lesion detection and characterisation [2)]
Prof. J. Hata, Kawasaki, Japan	13.10 - 13.30	Seeing the Unseen - New Clinical Findings by Novel Imaging Techniques [3)]

[1)] Dr. T. Fischer

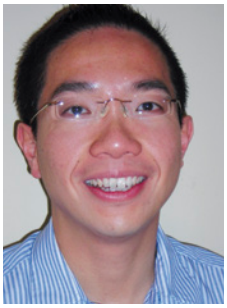
Dr. T. Fischer

Prostate: Men with an elevated serum level of prostate-specific antigen (PSA) or suspicious findings on digital rectal examination (DRE) are examined by transrectal ultrasound (TRUS). For histological confirmation and therapeutic planning, ultrasound guided systematic biopsy of the prostate is performed. However, in a subgroup of patients with elevated PSA levels, no malignancy is detected by biopsy or up to four biopsies are performed before prostate cancer is detected. A negative biopsy therefore does not exclude prostate cancer. In consequence, unnecessary biopsies with an increase of complications are performed in healthy men. Real-time MR/US image fusion may enhance cancer detection rates of TRUS-guided biopsies and contributes to lesion characterization by state-of-the-art US techniques. The study presented here for the first time compares state-of-the art US techniques after contrast medium administration with MRI and histology as the standard of reference.

Scrotum: Ultrasound is the imaging modality of choice for the examination of the scrotum. The propblem of tumour / haematoma misinterpretation can result in unnecessary orchiectomy. CEUS for the testis can be currently recommended for the differentiation between hypovascular and avascular lesions (benign).

Learning objects:
- To investigate whether multiparametric magnetic resonance imaging (MRI) allows lesion localization in prostate cancer in patients scheduled for MR/US fusion biopsy and whether the findings correlate with new ultrasound techniques
- Prostate lesions were classified on the basis of MRI and US (B-mode scan, power Doppler, elastography/TDI, CEUS)
- Targeted biopsies were performed in the MR/US fusionmode
- Indications for the use of CEUS in focal testicular lesions, secmental infartion, after trauma and abscess formation in severe epididymoorchitis.

[2)] Prof. A. Lim



Prof. A. Lim

This talk will encompass the latest technological developments of the Aplio 500 with particular focus on a few advanced applications for abdominal and small parts ultrasound. These newest developments include the improved visualisation of the microvasculature without the need for contrast and its potential clinical applications will be discussed. There have also been significant improvement in specialist applications such as elastography and also improved sensitivity in high frequency contrast technology. The latter now also allows reliable detection of the sentinel lymph node and their clinical impact will be outlined and illustrated.

Prof. J. Hata

3) Prof. J. Hata

In this session, the clinical experience of Superb microflow imaging (SMI), which is the novel application of Aplio 500 from Toshiba, is discussed. SMI is a unique ultrasound Doppler imaging employing multi-dimensional filter that makes it possible to depict minute vessels with slow velocity, without using contrast agents. In other words, the advantages of SMI are; 1.high frame rate, 2. high sensitivity, 3. high resolution, and 4. less motion artifact.

Therefore, SMI is useful in various situations encountered in daily practice. The evaluation of the density and the shape of tumor vessels with SMI help us diagnose and differentiate tumorous lesions and also could be the non-invasive modality for the assessment of therapeutic effect of chemotherapy. Since SMI clearly visualizes minute vessels, it can also be used to evaluate the disease activity in inflammatory disorders, even in bowel inflammation such as ulcerative colitis, Crohn's disease, and so forth. Furthermore, the diagnosis of organ ischemia can be done accurately with SMI, which is expressed as the focal defect of minute vessels in a real-time fashion, with high spatial resolution. In addition, SMI provides more sensitive view of minute vessels after the injection of contrast agent, which helps us to obtain the sustained dynamic image of microflow even after the first pass of the contrast agent.

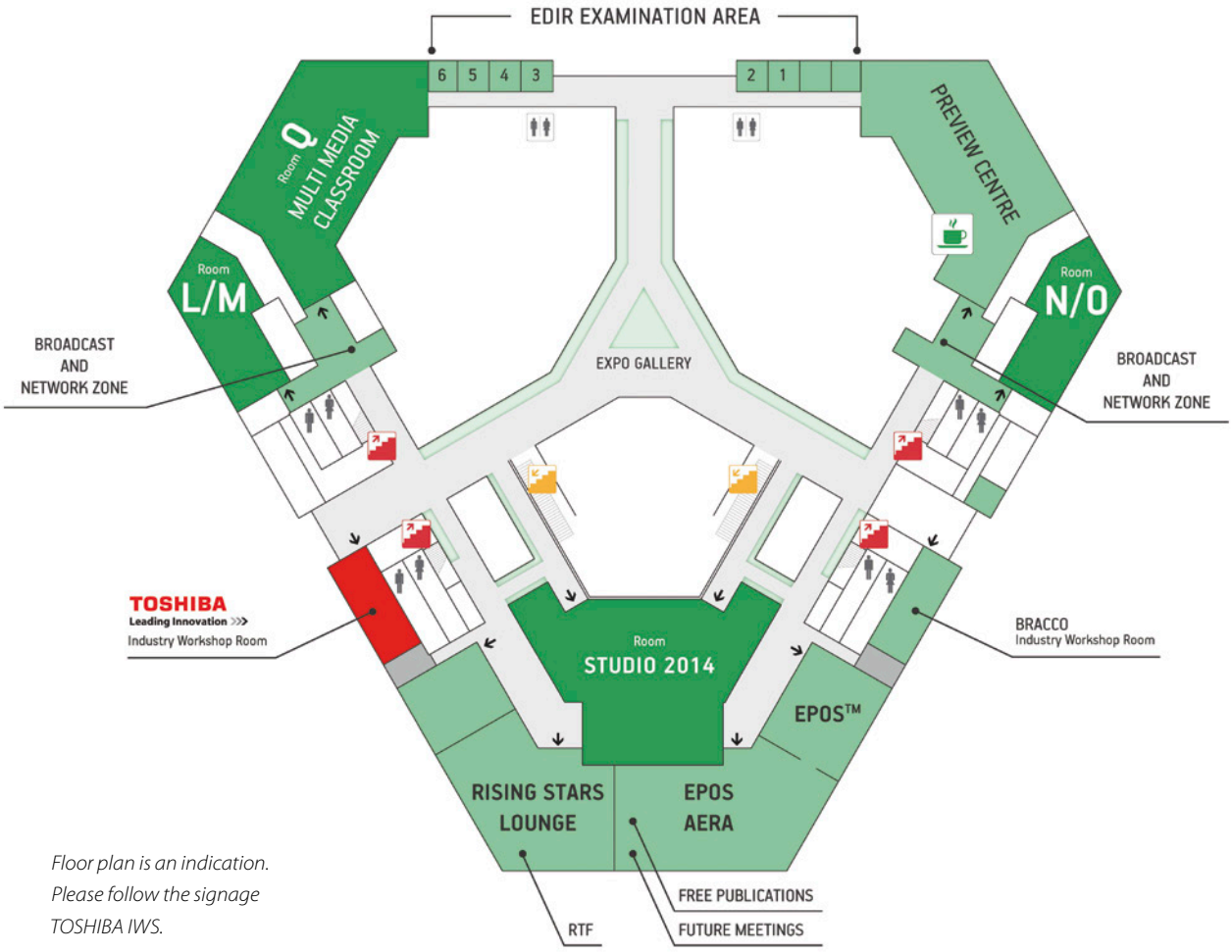
In conclusion, SMI, which provides the dynamic image of microvessels, is an essential tool for the diagnosis and the evaluation of various clinical conditions.

Toshiba Workshop

Sessions will be offered Friday, March 7 thru Sunday, March 9. Times as listed below in room Lounge 6 - Level 01 (max 20 seats).
Workshops are open to any ECR 2014 attendees. On-line registration in the **"myuserArea"** of the ECR web page.

Toshiba is offering a series of educational sessions for radiologists throughout ECR 2014. Each mentored workshop is preceded by a short lecture providing an overview on data acquisition, clinical use and image interpretation. Clinical cases will be analyzed and interpreted by participants on the workstations provided. The maximum number of participants per session is 20 (2 participants per workstation). CME credits will be provided, and the workshop language is English.

Date		Time Slot	Title
March 7, 2013	1	10:00 - 11:00	Ultrasound - Elastography Quantification, guest speaker: Dr. V. Cantisani, Rome, Italy
March 7, 2013	2	11:15 - 12:15	Ultrasound - Fly Thru Acquisition and Reconstructions, guest speaker: Dr. B. Smith, London, UK
March 7, 2013	3	12:30 - 13:30	Ultrasound - DCEUS in a multicenter study, guest speaker: Dr. N. Lassau, Paris, France
March 7, 2013	4	13:45 - 14:45	Ultrasound - Elastography Quantification, guest speaker: Dr. V. Cantisani, Rome, Italy
March 7, 2013	5	15:00 - 16:00	Ultrasound - Fly Thru Acquisition and Reconstructions, guest speaker: Dr. B. Smith, London, UK
March 7, 2013	6	16:15 - 17:15	Ultrasound - DCEUS in a multicenter study, guest speaker: Dr. N. Lassau, Paris, France
March 8, 2013	7	10:00 - 11:00	CT - Ultra low dose brain perfusion, guest speaker: Dr. E. Smit, Nijmegen, The Netherlands
March 8, 2013	8	11:15 - 12:15	ViTAL - Lung Density Analysis, guest speaker: Dr. S. Niehues, Berlin, Germany
March 8, 2013	9	13:45 - 14:45	CT - Myocardial perfusion, guest speaker: Dr. K. Kofoed, Copenhagen, Denmark
March 8, 2013	10	15:00 - 16:00	CT - Liver perfusion, guest speaker: Dr. H. Schöllnast, Graz, Austria
March 8, 2013	11	16:15 - 17:15	CT - Ultra Low Cardiac CTA, guest speaker: Dr. R. Bull, Bournemouth, UK
March 9, 2013	12	10:00 - 11:00	ViTAL - TAVR planning, guest speaker: Dr. S. Niehues, Berlin, Germany
March 9, 2013	13	11:15 - 12:15	CT - Ultra Low Cardiac CTA, guest speaker: Dr. R. Bull, Bournemouth, UK
March 9, 2013	14	12:30 - 13:30	ViTAL - Lung Density Analysis, guest speakers: Dr. S. Niehues, Berlin, Germany
March 9, 2013	15	13:45 - 14:45	CT - Liver perfusion, guest speaker: Dr. H. Schöllnast, Graz, Austria
March 9, 2013	16	15:00 - 16:00	CT - Myocardial perfusion, guest speaker: Dr. K. Kofoed, Copenhagen, Denmark
March 9, 2013	17	16:15 - 17:15	CT - Ultra low dose brain perfusion, guest speaker: Dr. E. Smit, Nijmegen, The Netherlands



Floor plan is an indication.
Please follow the signage
TOSHIBA IWS.

DCEUS Quantification Workshop Bracco/Toshiba

Saturday, March 8, 2014, 12.30 - 13.20 hrs, Room Lounge 1 - Level 01 (max 30 seats)

Quantification of Renal Perfusion

Moderator: Prof. Jean-Michel Correas, Paris, France

Bracco and Toshiba offer a 50 minutes educational session for radiologists on quantification of Dynamic Contrast Enhanced Ultrasound (DCEUS) based on the use of the Bracco quantification software VueBox™ and contrast-enhanced ultrasound sequences acquired with the Toshiba Aplio 500. Brief introductionary lectures will provide an overview of concepts in DCEUS quantification and in renal perfusion. In the hands on session, the participants will perform their own analysis of Toshiba Aplio 500 clips under the supervision of Prof. Jean-Michel Correas using laptops equipped with the VueBox software.

TOSHIBA

Leading Innovation

Want to be up-to-date on Diagnostic Imaging Innovations?

Join the Toshiba Sessions

Adaptive Diagnostics - Solving Clinical Challenges

Earn 1 CME credit!

Date: Friday, March 7, 2014
Time: 12.30 - 13.30 hrs
Room: Room B

Quantification of Renal Perfusion (Toshiba & Bracco)

Date: Saturday, March 8, 2014
Time: 10.30 - 11.30 hrs
Room: Room Lounge 1 - Level 01

Expanding Clinical Boundries in Ultrasound

Earn 1 CME credit!

Date: Saturday, March 8, 2014
Time: 12.30 - 13.30 hrs
Room: Room E1

Toshiba Workshops for the duration of ECR

CME credited!

Room: Software Demonstration Room, Lounge 6 - Level 01

Sessions open to any ECR 2014 attendees.
On-line registration in the "**myuserArea**" of the ECR web page.

Made for Life™

Time to ditch the chest X-ray? A comparison with CT

Dr. T.M.Aaløkken [1], J.F. Kristiansen MSc [2], Dr. A. Günther [3], A.C.T. Martinsen PhD [4]

Dr. T.M. Aaløkken

J.F. Kristiansen MSc

Dr. A. Günther

A.C.T. Martinsen PhD

[1-4] Oslo University Hospital, Norway

It is widely accepted that Computer Tomography (CT) is both more time consuming and expensive than chest radiography. Furthermore, CT incurs a considerably higher radiation dose than the conventional chest X-ray. Ideally we wish to combine the low-dose of the chest X-ray with the high image quality of CT, but this ambitious aim has, until now, not been possible. In this study we compared conventional chest radiography to 320-detector-row CT Aquilion ONE™ using advanced iterative reconstruction (AIDR 3D) in terms of image quality, radiation dose and laboratory time.

MATERIALS AND METHODS

We examined 13 patients with suspected pulmonary lesions, following chest radiography with ultralow-dose CT acquired on an Aquilion ONE scanner. Images were acquired at 135 kV and 10 mA, with 0.5-mm slice thickness and rotation time of 350 msec.

Three experienced chest radiologists rated both sets of images for pathological findings on a three-point scale, and image quality was rated according to nine criteria of the European guidelines for chest CT and chest radiographs.

RESULTS

Both image quality and the ability to detect and exclude pathology was strikingly better for ultralow-dose CT than for radiography. The radiation dose for CT and conventional radiographs was comparable and the laboratory time only marginally longer for CT.

In summary, we found the following:

- 33 relevant findings including 19 masses, nodules, and micronodules.
- Detection sensitivity for all observers and all findings was 18% ± 3% for radiography and 89% ± 2% for ultralow-dose CT.
- The positive predictive value for radiography was 37%, including 31 false-positive findings, while the positive predictive value for CT was 98% with two false-positive findings.
- Image quality for all readers was significantly higher for the CT images ($p < 0.05$).
- The average effective dose was 0.05 mSv for chest radiography and 0.105 mSv for CT.
- The average laboratory time was five minutes for chest radiography versus seven minutes for CT.

Figure 1: Above is a false-negative chest X-ray.

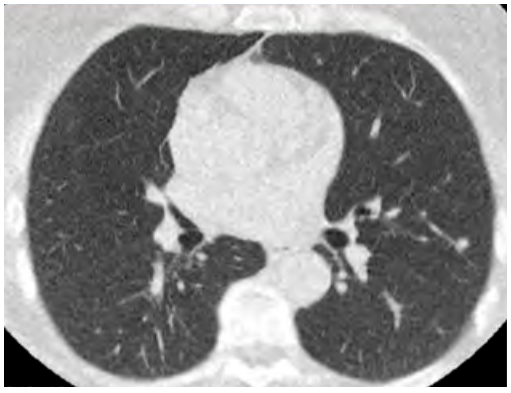


Figure 2: an ultralow-dose 3-mm axial chest CT of the same patient acquired on a 320-detector-row scanner (Aquilion ONE) and reconstructed with AIDR 3D shows a 7-mm nodule.

Figure 3: Axial (previous page) and Coronal (above) maximum-intensity projection (MIP) show a 7-mm nodule in the left lung and some atelectasis in the right lung.

CONCLUSION

The study demonstrated that the diagnostic yield from ultra low dose CT is far superior to that of chest radiographs.

Chest CT has traditionally incurred an effective radiation dose of approximately 4 mSv. Iterative reconstruction techniques now enable CT imaging at much lower doses and CT has become a fast and accessible modality. In this light the only remaining advantage of chest radiography is the low expense.

This work was presented at RSNA 2012. Moderator Dr. Narinder Paul from the University of Toronto rose the issue of an increase in findings with CT potentially leading to additional tests, costs, and risks.

AIDR 3D - ADAPTIVE ITERATIVE DOSE REDUCTION 3D

AIDR 3D is an advanced iterative reconstruction algorithm that reduces noise in both the three dimensional reconstruction data and raw data domains.

With the integration of AIDR 3D into SUREExposure controls, radiation exposure is automatically reduced before the scan, ensuring that the lowest possible dose is employed for the specific diagnostic objective irrespective of the size or shape of the patient. AIDR 3D integrated in SUREExposure 3D Adaptive can be applied to all acquisition modes for routine clinical use and is able to remove up to 50% of image noise resulting, which corresponds to a dose reduction of up to 75% by the same Standard Deviation (SD) for noise.

Clinical results show that AIDR 3D substantially reduces noise, while preserving sharp details, providing "natural looking" images. As well this new technology is especially good in artifact suppression (streaks, beam-hardening, etc.). Reconstruction performed with AIDR 3D permits substantial dose reduction when compared to scans performed with traditional Filtered Back Projection (FBP) techniques. The AIDR 3D algorithm is designed to work in both the raw data and reconstruction domains and optimizes image quality for each particular body region.

AIDR 3D integrated

Key features of AIDR 3D

- *Full integration in scan protocols for improved workflow*
- *Dose reduction in clinical setting by up to 75%*
- *Minimal penalty in reconstruction times*
- *Noise reduction and improved Spatial Resolution*
- *Superb artifact suppression*

The usefulness of a 320-row CT scanner in the oil industry

Shauna Cameron, P.Ag [1)]

Alberta Innovates - Technology Futures (Tech Futures) is part of an integrated provincial system that works to further research and innovation in Alberta, Canada. The priority of the corporation is to accelerate the development and growth of new and existing industries in agriculture, forestry, energy, environment, and health. To help meet research needs in Alberta, the Heavy Oil & Oil Sands (HOOS) group at Tech Futures acquired an Aquilion ONE™ CT scanner.

Shauna Cameron, P.Ag, Imaging Specialist

As a world leader in energy technology and innovation, HOOS works with companies to enhance the recovery of unconventional oil. The goal is to help oil producers engage in sustainable development of Alberta's resources through technologies that reduce costs, improve recovery, and decrease environmental impact. Research in this area is facilitated by the Aquilion ONE, which was purchased primarily as support for applied R&D in petroleum recovery and advanced materials. This article describes the use of CT with Aquilion ONE for research at Tech Futures.

Alberta Innovates - Technology Futures, Edmonton, Canada

COMPUTED TOMOGRAPHY AT TECH FUTURES

Through computed tomography, non-destructive examination of internal structure is accomplished and high-resolution 3D images of items like geological core samples and sand packs are created. A wide variety of reconstruction algorithms and post-processing options are used at Tech Futures to suit the material being scanned and the imaging needs of the customer. Accurate extraction of quantitative information from advanced image processing, along with 2D and 3D reconstructions, is often paramount. Quantitative information is delivered to clients by way of customized calibrations for each object or experiment scanned. Targeted noise-reduction techniques provide methods to acquire the best resolution possible. Specifically, this involves repeat scans and averaging data whenever possible to reduce noise. Further discrimination of materials can be done through dual energy scanning, which exploits subtle differences in attenuation spectra.

Tech Futures' current strategy is to design CT experiments conducive to the energy level and geometry of the Aquilion ONE. Low-attenuation vessels and materials suitable for X-ray use are considered in the experimental design stage. The speed of the scanner, for both the acquisition and reconstruction of data, makes it possible to track processes that change on a scale of minutes. This is invaluable for fluid flow experiments in cores and sand packs.

Efforts are also made to carefully register experiments when repeat scans are taken in order to successfully subtract images and uncover small changes in density. Orbital sync has been a useful tool in securing registration. This function ensures that the source and detector are located in precisely the same starting position for each repeat scan allowing the images to be either subtracted for discrimination of tiny density changes or averaged for noise reduction.

Radiation dose reduction is not critical to scans carried out at Tech Futures since subjects are not living. In fact, objects or experiments are scanned repeatedly at the highest available settings in order to extract the best quantitative information. Often, protocols are designed so objects are scanned in short lengths, with multiple volumes necessary to cover the desired length. This technique permits the highest allowable dose to penetrate objects much denser than the human body.

OIL RECOVERY FROM ROCK: DIGITAL ROCKS

One application for advanced imaging with Tech Futures' scanner is digital rocks, which is an emerging concept in characterizing reservoirs by obtaining physical properties directly from images of rocks. The technology combines

[1)] *Alberta Innovates – Technology Futures.*

CT at different scales (mm to micron resolution) with X-ray and scanning-electron microscopy (SEM) to create images of the internal structure of the pore spaces as well as minerals and organic matter within them. Such data can be very useful in studying pore architecture and physics of the processes happening during enhanced oil recovery (EOR). It is especially important for unconventional resources like shale, carbonate, tight gas, and coal seam gas. One of the most interesting aspects at this time is characterizing bitumen-bearing carbonates, especially fracture characterization.

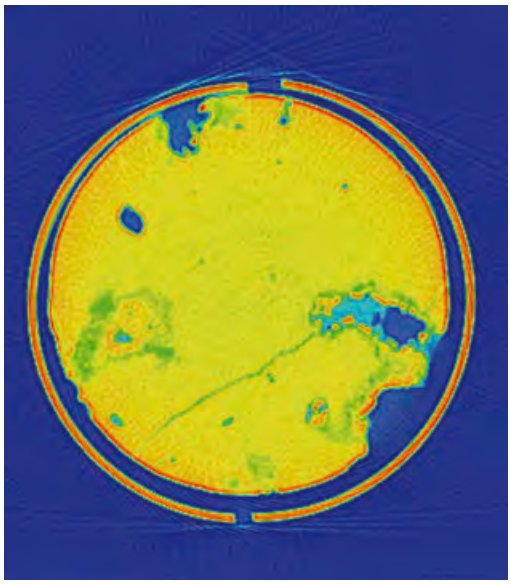
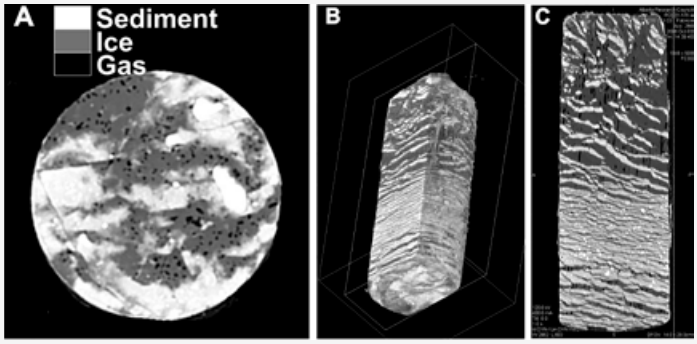


Figure 2: Axial image of Alberta Carbonate Core

Digital rocks enables Tech Futures to engage in a unique up-scaling effort of merging micro and macro imaging to observe a wide range of fluids, conditions, and detailed behaviour in EOR processes. The advantage of the technique is the considerable cost savings over securing individual laboratory analysis for each desired property. The procedure involves first obtaining full core mm-scale resolution scans with the Aquilion ONE scanner to identify sites representative of a range of image properties. This is followed by micro CT scans (approximately 10 micron resolution), available from various outsourced labs, which are suitable for sand packs or other very small samples. Imaging with sufficient resolution to resolve individual pores in a sand pack or a core is inevitably restricted to a very small volume. Simulation software is used to upscale the results of pore scale multi-phase flow simulations to obtain flow properties at each site and look for correlations between flow properties and

AQUILION ONE ASSISTS IN MEASURING PERMAFROST

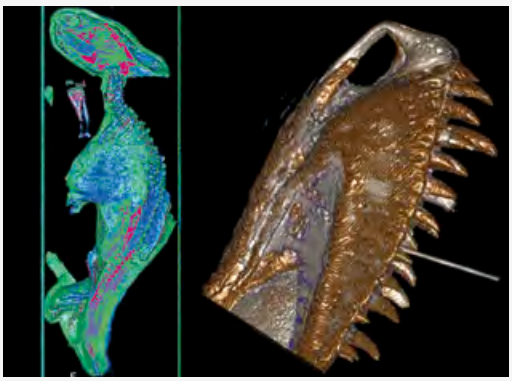
Water is trapped as ice in the permafrost of the world's artic regions. If the Earth is warming, the amount of water in the permafrost should decrease as the ice melts. How can we measure the ice in permafrost? The Aquilion ONE at Alberta Innovates - Technology Futures, is doing just such measurements. Permafrost cores are scanned and 3D volume rendered images are produced depicting ice and sediment. Quantitative measurements can also be made to determine the percentage of ice in each core. By imaging cores from the same region over many years, the change in the amount of ice can be measured.



Three images from CT data. (A) Axial slice; (B) 3D reconstruction; (C) Longitudinal slice. Soil is white, ice is gray and gas is black. Calmels, F., Froese D.G., and Clavano, W. Cryostratigraphic record of permafrost degradation and recovery following historic (1898-1992) surface disturbances in the Klondike region, central Yukon Territory. Can. J. Earth Sci. 49: 938–952

225 TO 65 MILLION YEARS IN THE MAKING

Dinosaurs first appeared 225 million years ago and died out 65 million years ago. Today most dinosaur fossils are found by doing fieldwork, but also during excavations for tunnels, buildings and drilling for oil wells. The Aquilion ONE at Alberta Innovates - Technology Futures scans these fossils to provide detailed information to paleontologists on the structures of the animals. Below are two examples of dinosaur fossils scanned with Aquilion ONE.



3D Image of a Juvenile Ceratopsian

3D image of the Snout (Antorbital Region) of a Tyrannosaur

Specimens are from the collections of the University of Alberta, Laboratory of Vertebrate Paleontology

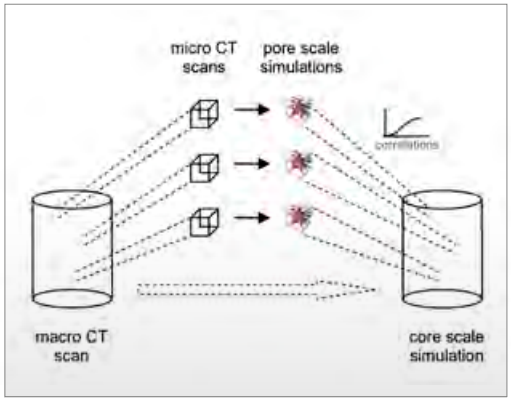


Figure 3: Merging macro and micro scanning to observe a range of conditions to determine the behaviour of enhanced oil recovery.

image properties. Properties are then mapped back onto the macro CT scan using the correlations and core scale flow simulations are performed with the results to make predictions for recovery from the oil reservoir.

OIL RECOVERY FROM SAND: IMAGING SAND PACKS

Other HOOS applications of the Tech Futures scanner include calculating porosities and saturations in sand packs, tracking solute in sand packs, testing solute uptake in oil, studying turbulent flow in water as well as laminar flow in oil, monitoring sand failure or production, and investigating the waterflood process used in oil recovery at the scale of sand grain pores.

CONCLUSION

The use of CT to image and quantify materials greatly assists scientists in determining potential sites for commercial oil extraction in unconventional materials such as carbonates and oil sands. This is a very interesting and different application of CT from its usual medical uses.

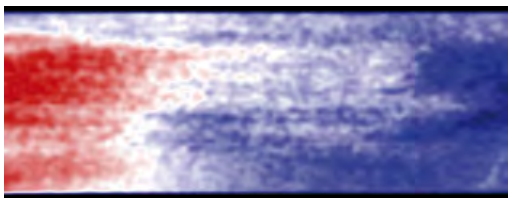


Figure 4: A sagittal section through a waterflood experiment in a cylindrical sand pack. Flow is from left to right. Blue indicates "unswept" regions with oil saturations of about 90%. Red indicates where water has displaced about 25% of the oil. This "synthetic radiograph" was obtained by averaging a number of sagittal slices near the axis of a cylindrical pack, to reduce noise and improve the spatial resolution.

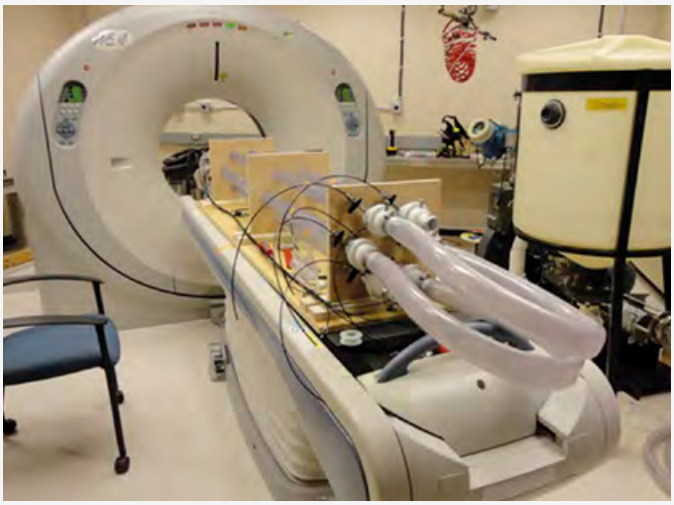
LOCAL SERVICE SEALS THE DEAL

Core experiments on the Aquilion ONE

Research is facilitated by the Aquilion ONE, which was purchased in 2013, primarily as support for applied R&D in petroleum recovery and advanced materials. This CT system was an upgrade to an Aquilion 64, which had been installed in the Edmonton facility in 2007.

The decision to purchase the original Aquilion 64 in 2007 was based partly on its ability to monitor dynamic processes. Another deciding factor was the presence of a local service base, which enables Tech Futures to obtain same-day service calls to address instrument problems. While the energy range of the medical scanner is lower than that of the industrial CT scanner HOOS used previously, the trade-off of higher energies and longer scan times for greater speed and local service was deemed favourable.

The speed of the scanner, for both the acquisition and reconstruction of data, makes it possible to track processes that change on a scale of minutes. This is invaluable to fluid flow experiments in cores and sand packs. The wide area coverage allows cores to be scanned in fewer sections and enhances the measurements of dynamic processes.



Flow Experiments on the Aquilion 64

Medical Imaging Enters the Next Generation

Ground-breaking Aquilion ONE Technology

The world's best scanner just got even better. The performance of Toshiba Medical Systems' Aquilion ONE™ has impressed radiologists in recent years but further enhancement and technical innovation have taken it onto a new level and added yet another dimension to CT imaging.

The next generation of Aquilion ONE offers enhanced workflow and patient comfort along with innovative new imaging tools.

AQUILION ONE NEXT GENERATION

The latest evolution of the leading dynamic volume CT system sees increased ease of use for radiologists and radiographers, better patient safety and comfort as well as outstanding image clarity. Like its predecessor, the next generation of the Aquilion ONE system has the ability to scan entire organs in a single gantry rotation. The 16 cm detector makes it possible to capture morphology at a single moment in time - be it a heart, foot, or an infant's chest - and eliminates movement artefacts. Patient comfort and safety are optimized by a larger gantry aperture and a newly developed Quantum VI detector, providing higher light output for optimized dose reduction.

The new CT is entering the market at a time when Toshiba Medical Systems is set to become an ever more important 'player' within the Toshiba Corporation and the corporation's healthcare sector already has plans for further expansion. **Satoshi Tsunakawa**, President and CEO of Toshiba Medical Systems Corp., Japan, emphasizes that the main aim of the business is to further extend the scope from medical diagnostics to new business to include disease prevention and patient care. Toshiba is already a key player in diagnostic imaging and has already sold 30,000 CT machines worldwide but believes there are further opportunities within the sector. "In order to realise this vision, our target for revenue in this year is 10% growth over last year," Tsunakawa adds.

Satoshi Tsunakawa, President and CEO, Toshiba Medical System Corporation, Japan

At the heart of that growth – and a critical component in the evolution of the new Aquilion ONE – is the strong ethos of innovation within Toshiba. Henk Zomer, Senior Manager of the CT Business Unit at Toshiba Medical Systems Europe, says that innovation is a strong theme running through the development of CT within Toshiba which has seen the company become the CT market leader in Japan. At present, it is in third place on the global stage but has clearly-defined aims to become the number one CT manufacturer in the world. "Innovation never stops," Zomer points out, and adds "it is a never-ending challenge between highly professional creative users and our engineers."

ADAPTIVE DIAGNOSTICS

What sets the next generation of Aquilion ONE apart is its flexibility and performance, making use of new innovations like Adaptive Diagnostics, including Dual Energy raw data analysis, Variable Helical Pitch, SEMAR (Single-Energy Metal Artifact Reduction) and new SURESubtraction applications. Adaptive Diagnostics is Toshiba's patient-centric suite of unique imaging solutions to simplify complex protocols and ensure consistent quality of results and simplifying workflows.

Meanwhile Dual Energy scanning is helping to bring greater consistency to clinical results. While anatomical structures attenuate X-rays differently, Dual Energy raw data analysis increases the amount of information available from CT imaging.

In addition the SURESubtraction applications provide clinical solutions to the challenges faced in everyday clinical practice: the brain subtraction algorithm enables accurate subtraction of the skull and medical implants; the neck subtraction deformable registration algorithm creates high-resolution images freed of bone structures; the lung subtraction provides iodine maps of the lung parenchyma with exceptional high contrast-to-noise ratio; and ortho subtraction ensures accurate subtraction of skeletal structures and calcified plaques.

With a constant focus on radiation dose, patient and staff safety, Toshiba developed fully integrated AIDR 3D (Adaptive Iterative Dose Reduction). AIDR 3D assists the radiologist in automatically saving dose on every examination while maintaining excellent diagnostic image quality at a radiation dose suitable for each patient.

A major challenge in CT remains the interpretation of scans from patients with metallic implants. This is where SEMAR technology plays a role by employing a sophisticated reconstruction algorithm to eliminate artefacts caused by metal while still improving visualisation of the implant. SEMAR can be used in routine low dose standard volume acquisitions and the combination with AIDR 3D provides excellent image quality.

INITIAL CLINICAL EXPERIENCE WITH THE NEW AQUILION ONE

Radiologists who have experienced the Aquilion ONE in recent years have been impressed with the next generation of this dynamic volume CT system.

Dr. Russell Bull is particularly impressed by the ease of use, image quality and integrated dose reduction of the new Aquilion ONE.

Image Quality and Workflow

Consultant radiologist **Dr. Russell Bull** from the Royal Bournemouth Hospital in the south of England has been using an Aquilion ONE since 2009. At that time, he recalls, the facility to cover a whole organ for the first time was a major leap forward in scanning for his department. But as he points out: "None of these advances matter unless they change the diagnosis or experience of the patient, the throughput or cost of procedure. If it is just clever that does not matter, but the Aquilion ONE completely

revolutionised our practice." He saw improved efficiency and throughput. "It increased scan efficiency and the volumetric scanning allowed use of much lower doses of contrast agent."

"We wondered whether it could ever get any better," he says, "but it did, we have now the Aquilion ONE Next Generation." He is particularly pleased with the new Quantum Vi Detector which he says has improved detector efficiency. "The improvements we have seen are large; much better patient experience from the large bore, very large patients receive low radiation dose and image quality is again better. There are fewer artefacts and less IV contrast is needed. Furthermore we have the ability to scan a wider range of patients as well seeing much faster reporting. As a result, the workflow has improved enormously."

"We always thought that our Aquilion ONE was the 'world's best scanner' but it is clear that the Aquilion ONE Next Generation is now the 'world's best scanner'. It is unbeatable for ease of use, image quality, low radiation and is completely revolutionising what we do."

Superintendent Technologist Matthew Benbow values the enhanced comfort Aquilion ONE offers for both his patients and his staff.

Matthew Benbow, who is a Superintendent Technologist at Royal Bournemouth Hospital, stated that the new Aquilion ONE has made important differences to his team.

The wider bore has made it more comfortable for patients, especially for those whose movements are restricted and those who are unable to place their arms above their heads. Aquilion ONE has been ergonomically designed for fast patient throughput and increased patient comfort, with the technology aligned in such a way to ensure that examinations are conducted with minimal steps.

Benbow said: "Our Aquilion ONE with motorized lateral table slide function allows the patient to be positioned without physical strain. This is an invaluable feature safeguarding the health, safety and wellbeing of radiographers from a lifting perspective".

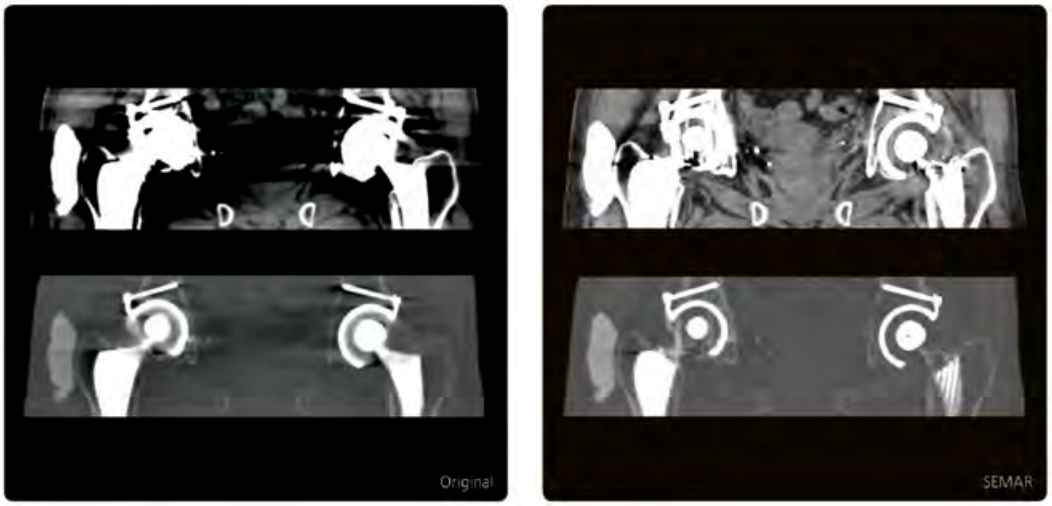
Prof. Alain Blum sees a significant increase in image quality with the new metal artefact reduction technology SEMAR, especially in patients with bilateral hip prosthesis.

SEMAR Metal Artefact Reduction

The Aquilion ONE has clear benefits across a whole range of innovative applications ranging from muscular-skeletal to the lungs. **Prof. Alain Blum**, Head of the Radiology Department at Service d'Imagerie Guilloz – C.H.U. Hôpital Central Nancy, France, believes that the new system offers "a huge step forward for the evaluation of soft tissues." Especially in the postoperative evaluation of patients with prosthesis, CT will play an increasing role. Since the classic CT scan is hampered by metal artefacts, new algorithms such as iterative reconstruction and SEMAR will definitely help to minimize those artefacts while presenting a better image quality – at a much lower dose than ever before.

A preliminary study of 68 patients with hip prosthesis recently conducted by Prof. Blum demonstrates that newly released Adaptive Diagnostics software for the Aquilion ONE significantly improves image quality, especially in those patients with bilateral hip prosthesis. In addition, he states a 30 percent increase in the detection rate of peri-articular pseudo-tumours.

Summarizing the advantages of the new developments Prof. Blum says: "CT is the only technique providing detailed information on the implants, bone and the soft tissue. By using iterative reconstruction and SEMAR,



SEMAR removes artefacts caused by metal and improves visualization of the implant, supporting bone and adjacent soft tissues for clearer and more confident diagnosis.

artefacts are significantly reduced and diagnostic image quality is dramatically improved. This will surely lead to an increase of CT-examinations for patients with hip prosthesis, so far difficult to examine."

Prof. Matthias Prokop points out that SURESubtraction Lung creates excellent iodine maps without increase of radiation dose.

SUBTRACTION LUNG IODINE MAPPING

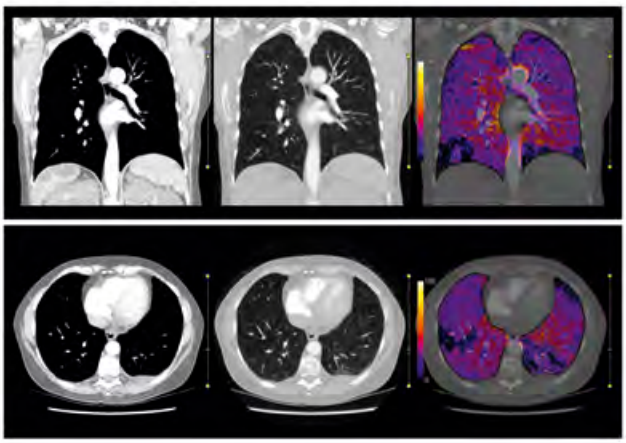
Prof. Mathias Prokop, Chairman of the Department of Radiology at Radboud University Medical Center in Nijmegen in The Netherlands, has evaluated SUBTRACTION Lung.

This newly developed Adaptive Diagnostics software creates iodine maps by subtracting a low-dose pre-contrast CT from a CT angiogram of the lung. "The iodine maps created by SUBTRACTION on the Aquilion ONE," Prof. Prokop points out, "have greatly improved signal and higher spatial resolution compared to iodine maps derived from dual energy acquisitions. SUBTRACTION Lung shows perfusion defects and thus provides direct insight in the effect of embolism on lung perfusion. By providing a perfusion map of the lung it can help clinicians find small emboli they could have missed otherwise. It also has enormous unexplored potential, for example with regard to diagnosing the activity of interstitial lung disease, or evaluating the interaction between aeration and perfusion in diseases like emphysema or small airway disease."

In acute and chronic pulmonary embolism studies SUBTRACTION Lung creates excellent iodine maps without increase of radiation dose. "SUBTRACTION Lung," Prof. Prokop underlines, "is an easy to learn technique with simple scanning procedures and fast processing times that do not burden the workflow. In short, a very powerful technique with outstanding image quality."

SUMMARY

The next generation of Aquilion ONE marks a major step forward in scanning technology enhancing the whole CT experience for the patient and the health professional. With reduced radiation dose, less contrast agent, quicker delivery of results, improved imaging and increased versatility it offers a major advantage in technology and helps lead to better patient diagnosis and outcomes.



SUBTRACTION Lung provides iodine maps of the lung parenchyma with a high contrast/noise ratio. The color overlay allows easy identification of hypo-perfused areas.

Planning a Hybrid Lab

Angela Nightingale [1)]

Angela Nightingale

[1)] *Toshiba Medical Systems Ltd, Crawley, United Kingdom*

Whilst it may seem a simple task to combine an imaging suite with a surgical one, there are many challenges that have to be met to achieve an environment that works well for all.

Advanced technology is changing the way surgery is being performed, with minimally invasive techniques being applied to many areas. To undertake these complex procedures a new 'Hybrid' operating and imaging environment has been developed which combines a full operating theatre with high level surgical facilities and advanced imaging equipment.

There needs to be a great deal of thought given to whether it is even appropriate, so there should be detailed analysis of what procedures will be undertaken, in what numbers and by whom, to ensure that the maximum use will be made of such a major financial investment. In some cases it may be more appropriate and financially prudent to install separate facilities.

If the clinical and financial indications are positive, then all the stakeholders must be identified at a very early stage, their input sought and a room usage plan developed. These high technology rooms require too large an investment to be used on a part time basis, so care should be taken to maximise use.

CLINICAL INDICATIONS FOR A HYBRID LAB

Cardiac

Initially developed for Paediatric Cardiology, use of hybrid labs has expanded into adult surgery with coronary revascularisation, trans catheter valve replacement (TAVI) and repair, left ventricular assist devices (LVAD's) and aortic stent placement ideally performed in such an environment.

Tavi

Trans catheter replacement of aortic valves is still limited to patients at high risk during conventional surgical techniques. The European Societies of Cardiac Surgery and Cardiology have recommended the hybrid environment as the ideal for these new less invasive techniques.

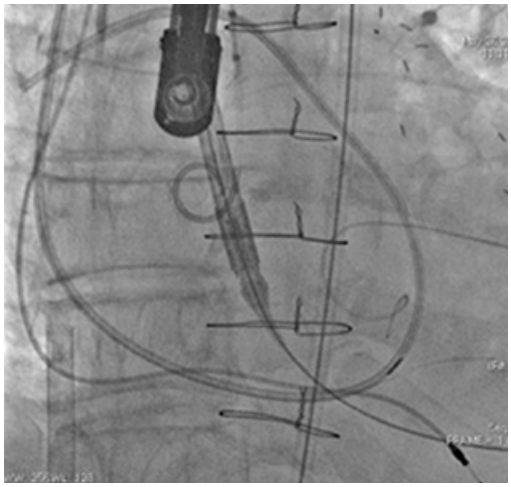


Figure 1: Tavi procedure picture

Congenital heart disease

In certain groups of patients and conditions the combination of imaging and a percutaneous approach reduces the challenge of navigating complex anatomy, bypass time, overall risk and therefore improves outcomes.

Coronary artery disease

Primary diagnosis will always be via CT or a conventional Cath, but in cases of graft failures research suggests that 13-20% could be diagnosed and then immediately repaired, but currently the two procedures are generally regarded as separate options. A hybrid approach can decrease morbidity and mortality when compared with conventional surgery.

Endovascular aortic repair

Endovascular repair of the descending aorta (EVAR) is a well-established technique with a higher survival rate than open surgery, but only recently has the same technique been applied to the rest of the aorta. This is often combined with open surgery, a situation for which a hybrid lab is ideally suited and minimises risk for the patient.

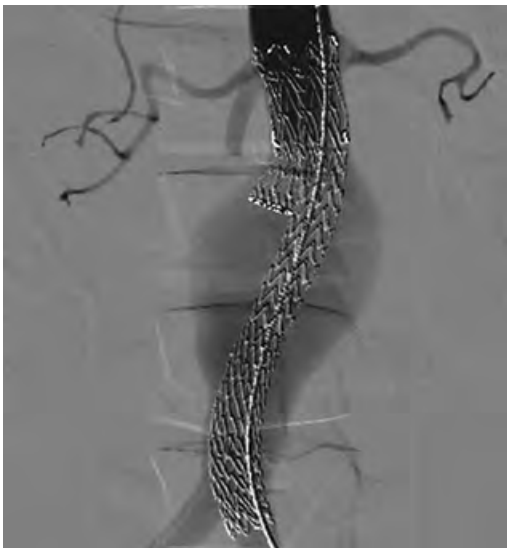


Figure 2: Evar procedure image

Pacemaker and icd implantation

The hybrid lab offers better imaging and superior angulation than a mobile unit and higher infection control than a conventional lab, minimising risk.

EP

Theoretically the combined use of surgical epicardial and interventional endocardial approaches for atrial fibrillation can offer advantages over conventional EP treatment.

Non Cardiac

The last two decades have seen a paradigm shift in the treatment of vascular diseases, from traditional open surgical repairs (OSR) to percutaneous interventions. Neither the classic operating room nor the conventional angiography suite is optimal for both.

Thoracic aortic aneurysm

Diseases of the thoracic aorta are currently commonly being treated by transfemoral endovascular procedures, avoiding the inherent morbidity of other more invasive procedures and involving a considerably shorter recovery period.

Abdominal aortic aneurysm

When aortic repairs are combined with revascularisation or embolisation of other vessels the need for a combined imaging and surgical facility becomes essential.

Limb ischaemia

Endovascular treatment has also gaining in acceptance for the treatment of chronic limb ischemia. Many of these patients have multilevel disease so that iliac and femoral revascularisation is often needed, sometimes in conjunction with the popliteal segment.

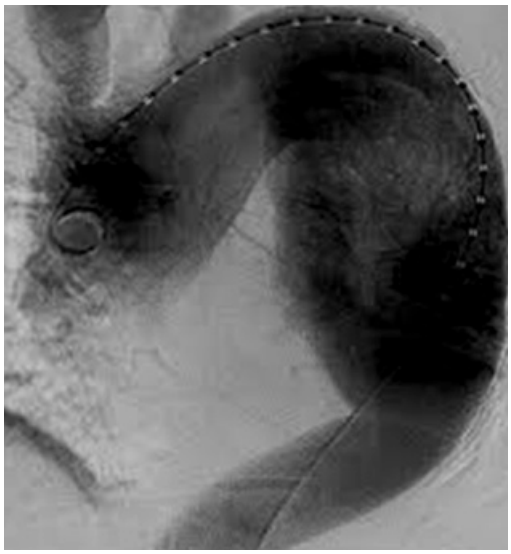


Figure 3: Aortic aneurysm repair

Neuro-interventional

For Neuro-interventional procedures, a hybrid theatre can provide clinical benefits in stroke, aneurysm, trauma, paediatric and more complex cases. New procedures, such as endovascular neurosurgery, are evolving as the latest imaging equipment can provide advanced image guidance to allow more accurate positioning of Catheters, stents, coils and guide wires.

Figure 4: Avm embolisation image

PLANNING A HYBRID THEATRE

Addressing all clinical needs

For the successful development of a hybrid lab the roles of each of the stake holding groups need to be understood and taken into account. The key internal people who should be involved on hybrid suite planning committees include the surgeons and cardiologists who will use the facility, the theatre and imaging lab staff, surgical nurses, IT staff, facilities/estates manager, infection control personnel, hospital engineers and directorate management. External stakeholders are major equipment manufacturers, the architect, M and E consultants, structural engineers, electricians and IT.

Location, location, location

It is generally simpler to put a hybrid room close to or in an Operating Theatre environment as the infrastructure to support its use is close at hand, rather than try and reproduce a full surgical environment in an open department. In a theatre, positive pressure ventilation, sterilisation equipment, scrubs, etc., are all available so do not need to be duplicated.

Size does matter

A hybrid lab needs to be substantially larger than either a conventional surgical theatre or an interventional imaging room as, unlike an imaging only room, there needs to be space to park the imaging equipment out of the way of the surgical area.

Physical room considerations

Interventional imaging equipment may suspended from the ceiling, located on the floor, or both, so the floor and ceiling strength needs to be determined, before a choice of equipment is made. Ceiling mounted systems require a minimum and maximum height for installation which may be difficult to achieve in an existing space.

Ancillary rooms

These should include patient preparation and recovery areas, clean and dirty utility, staff areas and offices. If the Hybrid room is located in the same area as other operating theatres, this will allow sharing of some of these facilities, reducing cost and increasing usage rates.

Construction access

Typically the imaging equipment in a hybrid room is delivered in one or two very large pieces which require a delivery route with minimum door and ceiling heights and widths, which should be taken into account when looking at potential locations.

IN-ROOM PLANNING

Radiation protection

A radiation protection advisor should be consulted when planning the layout of the area so that they can advise on the level of protection required, which may include lead shielding of wall/doors, radiation warning lights and local rules.

When selecting the imaging equipment for the room, input should be sought from radiology or cardiology staff to look at clinical examination dose levels v image quality and potential dose saving features of each system.

Lighting
There are many different types of lighting that need to be planned in this type of suite – general/ambient, general surgical and procedure specific. The various users of the room should suggest the lighting they need and the project manager and building works contractor will plan a scheme in conjunction with specialists if needed.

Anaesthetic considerations
In an ideal situation the positioning and type of these facilities would suit every surgeon's/anaesthetist's preference and procedure type, but this is rarely possible. Ceiling mounted units will provide the maximum flexibility whilst keeping the floor clear of obstructions, facilitating high levels of infection control and the best access to the patient.

Air conditioning
Full compliance with current codes of practice and guidelines for a surgical theatre will be required. Imaging equipment has an temperature range for optimum reliability and image quality and its heat output and that of other equipment in the room will need to be included in all air conditioning calculations. Specific surgical procedures may also require specialist environmental conditions and these should be taken into account.

It considerations
Hybrid surgical suites are often one of the most technologically advanced rooms in a hospital, so the suite will require multiple network points to access patient records, previous studies and other data, which may also require additional display monitors.

External AV conferencing is also frequently required which will need to be planned for – microphone and camera positions, network points, bandwidth etc. all have to be part of the suite specification.

Infection control
It is important that the site's IC department is consulted at an early stage to ensure that their recommendations are incorporated into the design of the suite and possibly the choice of equipment within the lab.

Storage/catheters
Opinion on storage for Catheters, devices, consumables and other theatre items varies widely and will largely depend on local opinion and the predominant use of the room. For imaging there may be a need to store Catheters within the room and appropriate cabinets will need to be installed to comply with local infection controls regulations. If space permits it may be better to have a storage area adjacent to and accessible from the theatre itself.

ADDITIONAL EQUIPMENT

Specialized Equipment
The list of additional equipment that may be used in this type of environment is almost infinite and will change over time as new procedures are developed.

Imaging equipment choice

C-Arm
For the successful implementation of a hybrid suite the choice of imaging equipment is of vital importance. Increasingly complex procedures require high quality imaging with a choice of acquisition and display modes such as rotational and 3D angiography, CT like images and stent enhancement as well as integration with other diagnostic and treatment technologies. The first choice to be made is between a mobile C-arm and a fixed system.

Mobile systems
This type of C-arm is in common use in Theatres and is used for many surgical applications. However the power output and image quality are insufficient to show the fine vessels and guide wires that are used in hybrid procedures.

Fixed systems
A fixed system has the ability to move quickly and easily to a park position and offers flexibility in positioning, without compromising clinical working. Lateral movement is desirable to allow easy access to both sides of the patient with minimal table movement. The size of the flat panel detector (FPD) and its housing should also to be considered, as there is wide variance which will impact positioning and dose levels.

Mono or biplane system
Any hybrid suite is a very crowded area and a biplane system makes use of the theatre more complex, with reduced patient access. Single plane systems

Procedure Mix Equipment Recommendations

Procedure	Table Type	Infinix-i Cardiovascular Systems
Majority Endovascular	Hybrid Cath Table/ Tilting Angio Table/ Conventional Angio Table	Single Plane Ceiling/ Single Plane Floor/ Biplane
Primary Pediatric Endovascular		Biplane
Primary Neuro Endovascular		Biplane
Primary Adult Endovascular Greater than 70%		Single Plane Ceiling/ Single Plane Floor/
Wide Mix of Endovascular, Open Vascular, General Surgeries	Hybrid Cath Table/Conventional OR Table with Vascular and Universal Tabletops	Single Plane Ceiling/ Single Plane Floor/
Majority Open Surgical	Conventional OR Table with Vascular and Universal Tabletops	Single Plane Ceiling/ Single Plane Floor/

Figure 5: Operation view (tumour arrowed)

are generally the system of choice for most vascular, cardiac, GI and orthopaedic suites. A biplane system may be considered for dedicated neuroradiology, paediatric cardiology or electrophysiology hybrid theatres, but the actual use should be clarified with all stakeholders to ensure that the need for Biplane imaging outweighs the drawbacks of the room complexity.

Floor or ceiling mount

Ceiling mounted systems generally have a greater range of movement, take up no floor space and are easier to park away from the operating table. Floor-mounted systems have no overhead cabling or ceiling tracks above the operative field, reducing the infection control burden. Reconciling these two aspects is an individual choice, but the majority of hospitals decide on ceiling mount as they provide best access to the patient without the need to move the table and the most flexible use of the theatre.

Table

The challenge in selecting a table for a hybrid theatre is the compromise between imaging and surgical needs. Surgery needs a breakable table that can be customised with different tops and accessories to cater for the varying types of procedures that will be undertaken, but imaging requires a radiolucent floating table top which is not available with surgical tables. For 3D and CT like imaging the table needs to be integrated into the imaging system and so the choice of tables is normally limited to the one that is standard on the system and one or two theatre type tables.

SUMMARY

Implementation of a hybrid surgical/imaging suite is a complex process involving many different clinical and non-clinical disciplines with different requirements and priorities. Keys to a successful and economically viable outcome are consultation, accurate understanding of the purpose of the suite and detailed planning.

Dual Energy CT in the PRIME Time

Dr. Orla Buckley [1)]

The storms of the 'slice war', 'gantry rotation war' and 'dose war' have calmed, for now. Significant technologic advances are now available such as 320 detector row panels with 16cm volume coverage and remarkable gantry rotation times (275ms) on the Aquilion ONE™ (Toshiba). Toshiba AIDR 3D technology has shown the effective dose exposures can be reduced by up to 75%. What is next for CT, what battle to choose now? Huge advances in spatial and temporal resolution aren't enough? CT now leaps further into the realm of tissue characterisation like its rival MRI?

Dr. Orla Buckley

By virtue of the interaction of emitted xrays from the CT tube with the k-edge of matter, CT has not had difficulty differentiating anatomic structures with significantly different composition or atomic number. The attenuation coefficient of photons varies significantly with differing k-edge binding energies. Fat, bone or air for example will not be mistaken on CT. The challenge arises for matter with similar k-edge binding energies. Two materials will behave differently at differing photon energies, depending on the elements they are composed. Matter with a high atomic number such as calcium has a higher change in attenuation at differing kVp energies than uric acid for example, which has a lower atomic number.

By emitting two different photon energies, 135 and 80 kVp, matter with close k-edge binding energies can be differentiated. Aquilion ONE and Aquilion PRIME (Toshiba), are amongst the scanners that are leading the way in this new era of CT technology.

PRACTICAL CONSIDERATIONS FOR DUAL ENERGY CT

1. Noise and image quality:
How to prevent noise on the low dose scan?
Although two separate volumes with separate energies are acquired, the Toshiba's DE technology automatically adjusts the mA settings for each kVp to provide image volumes with similar signal to noise ratios.

2. Coverage:
Complete coverage of a region is acquired at both energies by using a very low pitch. Scan start times are synchronized. With the z axis resolution of 16cm in the Aquilion ONE, volumetric scanning of a solid organ can be acquired with two temporally uniform data sets provided. Any potential for motion artifact is eliminated with this capability. Scanners with less detector rows take advantage of a very low pitch to ensure coverage of the required volume.

3. Radiation exposure:
Low pitch, dual energy exposures… Is this recipe for high radiation exposure? Depending on the body mass of the patient and the volume of the target organ, the mA can be manually set to a higher or lower on the console prior to scanning. Secondly, exposure can be manually turned OFF in the upper part of gantry rotation that would expose the ventral side of the patient and potentially radiation sensitive areas such as breast tissue in females (Fig. 1).

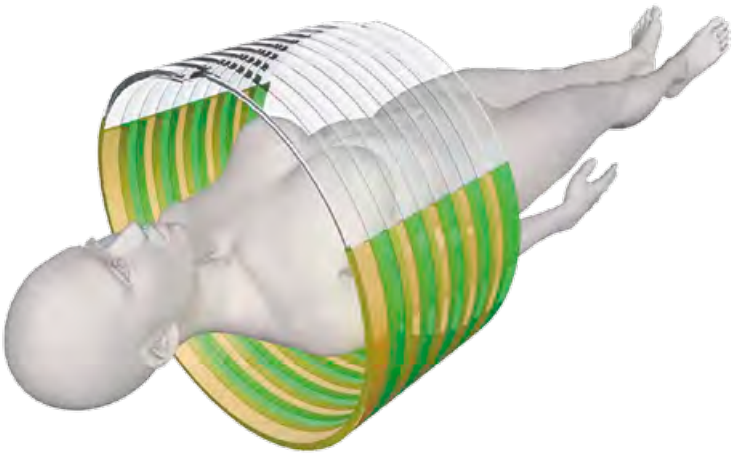


Figure 1: Tube exposure can be manually turned OFF in the upper 180° of gantry rotation that would expose the ventral side of the patient and potentially more radiation sensitive areas such as breast tissue in females.

[1)] *Tallaght Hospital Ireland*

Although noise is reduced by automatic adjustment of the mA settings on the low dose scan, the DE images will often appear 'noisier' than the diagnostic standard exposure. Radiologists need to recognize that the dataset will provide images with low noise for general diagnosis in addition to lower kVp data, which is used for the tissue decomposition algorithm.

4. Post processing

Post processing of the image datasets produces not only color-coded cross-sectional images but three-dimensional, 360° rotational volume-rendered models. This is a relatively automated process. As an example, in the setting of analysis of renal stone composition, a two material composition algorithm is utilized to separate stones composed of uric acid from other compositions such as calcium or struvite, Colour coding of the post processed data set readily identifies the composition of the stone.

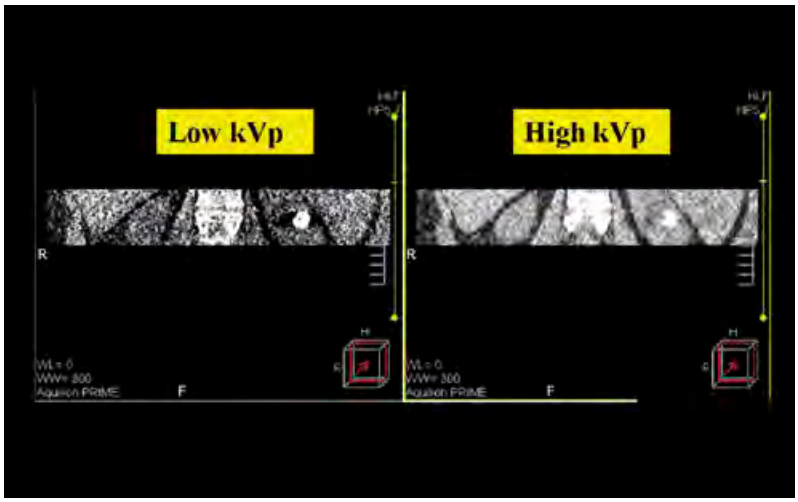


Figure 2a: Coronal CT images of the kidneys at low kV, high mA (left), high kV, low mA (right)

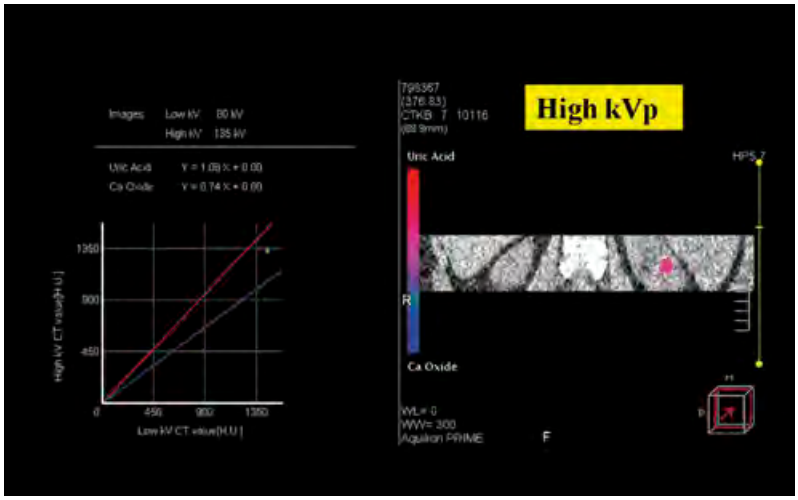


Figure 2b

5. What can Dual Energy CT do?

By virtue of its ability to differentiate tissue composition and behavior of matter at different energies, DECT can characterise matter, can be used to generate virtual non contrast data sets and can enhance depiction of iodine containing structures at low energy exposures.

CLINICAL APPLICATIONS

Case 1

A 62 year old male patient presented to the emergency department with renal colic. Background history includes obesity, hypercholesterolaemia and a personal history of renal stones. Dipstick urinalysis demonstrates microscopic haematuria. Review of prior imaging demonstrates a longstanding left lower pole renal stone measuring 1cm. Discussion with the urology service indicates prior failed lithotripsy.

CT KUB was ordered (Fig. 2). A dual energy protocol was performed to identify the composition of the known stone in light of prior failed lithotripsy.

Fig. 2a and 2b are select coronal images from the DECT acquisition. Fig. 2a illustrates the coronal CT images of the left kidney at the high and low kVp with adjusted mA. The 1 cm high attenuating renal calculus is seen at the lower pole of the left kidney. Application of the colour coded decomposition algorithm indicates this stone is made of mixed composition.

10 % of renal stones are composed of uric acid. Lithotripsy is of reduced therapeutic benefit in these patients compared to other stone compositions and urine alkalinisation can be a better therapeutic option. At our institution, a National Urology centre, renal stone characterization has had a big impact on stone management. Alternate pathways of treatment are suited to different stones and DECT permits this characterization. Some are suitable for lithotripsy, uric acid stones response to urine alkalinisation and very high density stones such as brushite stones may be refractory to all non-invasive treatment and percutaneous nephrostolithotomy is the best therapeutic option. Recognition of the stone composition and selection of appropriate therapy results in better clinical outcome, better patient satisfaction as a result and also economic benefit.

Case 2

A 64 year old gentleman presented to the Rheumatology clinic in August 2012 with a 20-year history of joint pain and swelling. His symptoms had started in the right second metatarsophalangeal joint (MTP). Subsequently over years this progressed to involve his elbows, ankles, knees and fingers and toes. At presentation he was taking NSAIDs, allopurinol and colchicine as prescribed by his general practitioner.

Joint aspirate was non diagnostic. Ultrasound of the small joints of the hands was suggestive of gout.

Although the clinical picture was highly suggestive of gout, prior to initiation of uric oxidase infusions, DECT was performed to confirm the presence of uric acid and quantitatively assess tophus burden so treatment efficacy could be monitored on serial scanning.

DECT of the hands and feet was acquired as shown in Fig. 3 and Fig. 4.

DECT allows earlier detection of gout before erosive changes have taken place. Clinically challenging cases where the cause of the inflamed joint is unclear and serum biochemistry and ultrasound are equivocal often occur and DECT can provide a definitive answer as the presence of uric acid crystals or other causes. With the advent of new costly uric acid pharmacologic agents such as the new recombinant uric oxidase agents, there is greater pressure to determine tophus burden before, during and after treatment to try and prove efficacy of treatment. The ability to perform volumetric analysis of the tophus burden is of particular utility in quantifying response to treatment.

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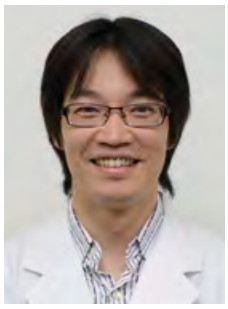
2. Desai MA, Peterson JJ, Warren Garner H, Kansdorf MJ. Clinical Utility of Dual Energy CT for Evaluation of Tophaceous Gout. Radiographics 2001; 31: 1365-1375.
3. Coursey CA, Nelson RC, Boll DT, Paulson EK, Neville AM, Marin D, Gupta RT, Schindera ST. Radiographics. 2010 Jul-Aug;30 (4):1037-55

Figure 3: Extensive uric acid deposits are demonstrated in these volume rendered images and Multi Planar Reformat images. In these images acquired using dual energy with application of a gout algorithm, uric acid crystals are coded in red. Gout is present at the second MCP in particular where a volume of 0.22cm3 of crystal deposit is present.

Figure 4: Uric acid deposits colour coded in red at the first MTP joint associated with underlying bone erosions (osseus erosions better depicted on bone algorithm). Volumetric quantitation of the uric acid deposits provided, 0.37 cm³ in this example.

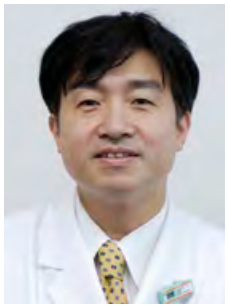
Dual Energy Raw Data Based Decomposition Analysis on Aquilion ONE

Dr. Fuminari Tatsugami [1], Dr. Toru Higaki [2], Dr. Kazuo Awai [3]



Dr. Fuminari Tatsugami

Dr. Toru Higaki



Dr. Kazuo Awai

Dual energy raw data based decomposition analysis has recently become available on the Aquilion ONE™ CT scanner. Monochromatic images are generated using this technique. Research performed at other sites has indicated that monochromatic images may have clinical value. In this article we outline our investigations into the use of this technology in both phantom experiments and in two clinical cases.

Dual energy CT, in which the subject is scanned at two different energies (tube voltages), can be used to perform material decomposition based on the differences in material absorption coefficients at different energies and also to create reference material images for various types of analysis. Specifically, it supports material decomposition, the creation of iodine maps and virtual non-contrast images, effective atomic number analysis and electron density analysis.

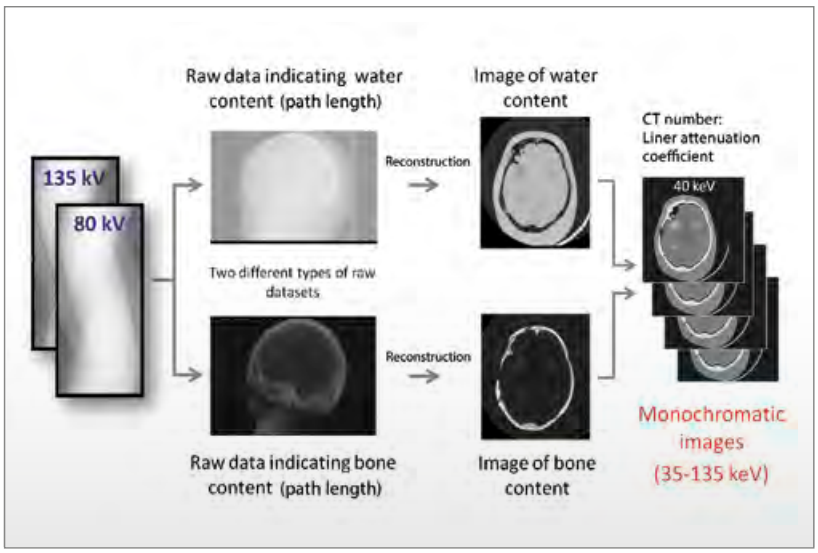


Figure 1: Raw data-based dual energy analysis uses projection data from two different energies. Two raw datasets based on water and bone densities are created and reconstructed into volumes. These volumes are used to generate monochromatic images.

The basic requirements for dual energy analysis are that the datasets must be temporally and spatially matched. Specifically, there must be no temporal difference between the two scans and the tube orbits must match. It is also important that there should be a large difference between the two energies and the exposure dose should be adjusted so that the noise levels are the same.

Aquilion ONE supports dual energy imaging and analysis using both volume scanning and helical scanning. In volume scanning, it is possible to switch the tube voltage between 135 kV and 80 kV in as little as 0.2 s. In helical scanning, a mode in which exposure is performed only from the patient's back is provided to minimize X-ray exposure to the breasts.

Dual Energy analysis methods can be broadly classified into two types: image-based analysis and raw data-based analysis. In Aquilion ONE, it is possible to perform raw data-based analysis using volume scan data. Analysis using raw data has been shown to produce more accurate dual energy results than image based analysis.

RAW DATA-BASED ANALYSIS

In raw data-based analysis, the count values (raw datasets) acquired at two different energies are used for calculation. Specifically, the human body is assumed to be a mixture of two different materials such as water and bone or water and iodine, and the content of each material is calculated from the two count values (raw datasets) obtained by dual energy scanning (Fig. 1). Since the Liner attenuation coefficient of each material is known, the CT

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number at a given energy can be determined by combination with the calculated content, making it possible to create monochromatic images (keV images).

Novel analysis software which utilizes raw data based dual energy data available on the Aquilion ONE includes reduction of beam hardening artifacts, automatic generation of the best CNR images, virtual non-contrast image, iodine map, effective atomic number and electron density imaging. Among these new technologies, electron density images has gained attention of radiologists and radiation oncologists because it is a promising method for generating more accurate electron density images than conventional methods in radiotherapy planning.

We performed phantom experiments to verify the accuracy of this method.

Aquilion ONE

PHANTOM EXPERIMENTS

Improvement of beam hardening artifacts

When two syringes containing a high-absorption material (iodine with a CT number of approximately 1000 HU) are placed in a phantom filled with water and scanned at a single energy, severe beam hardening artifacts are observed between the two syringes. The beam hardening artifacts are still seen in the Virtual 120kV image generated using image based dual energy analysis. In a monochromatic image created by raw data-based dual energy analysis, the beam hardening artifacts are significantly reduced (Fig. 2).

Best CNR image

The use of monochromatic images makes it possible to obtain an image with the highest possible contrast-to-noise ratio in the region of interest (called the Best CNR image). The results of comparison between image-based analysis and raw data-based analysis showed that the CNR was approximately 5% higher for raw data-based analysis. It is considered that beam hardening artifacts in high-absorption materials are reduced, resulting in more accurate CT number measurement in the subject.

Virtual non-contrast image

Investigations using a water phantom containing syringes filled with fat and with iodinated contrast medium at seven different concentrations showed that both the iodine map and virtual non-contrast image obtained using the raw data-based analysis tool were superior. In the raw data-based analysis, the influence of beam hardening artifacts was reduced and the CT number accuracy in the virtual non-contrast image was improved.

Effective atomic number and electron density

It is possible to determine the effective atomic number and the electron density of an object using the raw

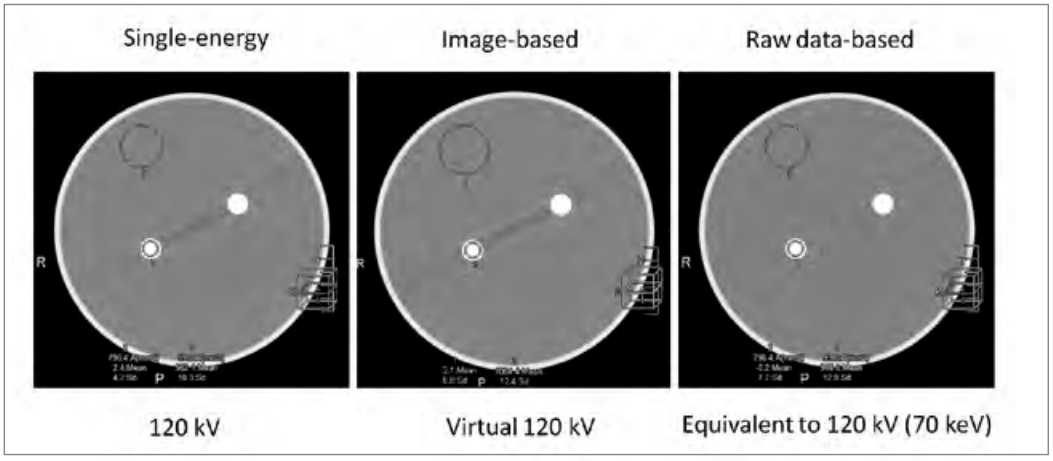


Figure 2: Beam hardening artifacts seen in a single energy 120kV image, image based dual energy image and monochromatic raw data based dual energy image.

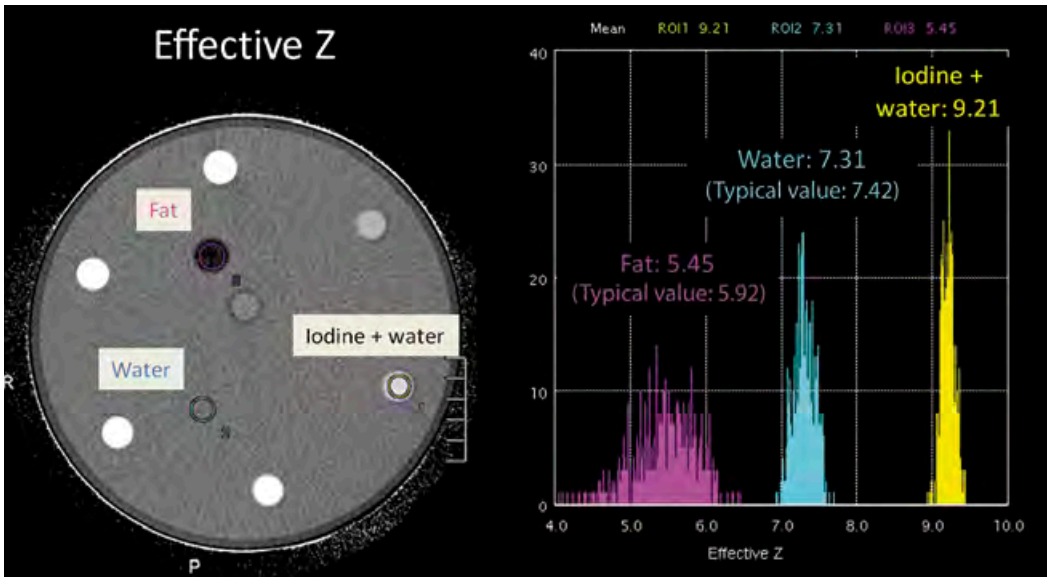


Figure 3: The measured values for water and fat were close to the typical values for these materials. For iodine, the higher the concentration, the higher the effective Z value, the lower the concentration the closer the effective Z value is to water.

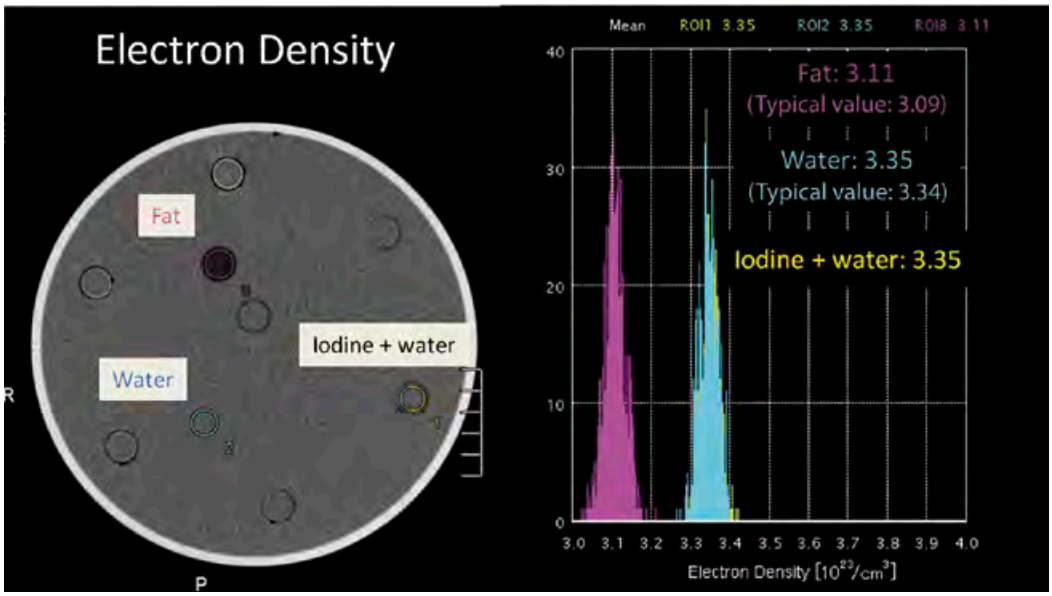


Figure 4: The measured electron density values for water and fat were close to the typical values for these materials. The iodine measurements were equivalent to water, regardless of concentration.

data-based analysis application. The fat and water in the phantom were measured to determine their effective atomic numbers. The measured values were 5.45 and 7.31, respectively, which were quite close to the typical values of 5.92 for fat and 7.42 for water (Fig. 3). The higher the iodine concentration, the higher the effective atomic number.

The measured electron density values for fat and water were 3.11 and 3.35, respectively, which were also quite close to the typical values of 3.09 for fat and 3.34 for water (Fig. 4).

CLINICAL CASES

Raw Data based dual energy analysis methods were then applied to two clinical cases to understand the clinical value of this application.

Improvement of beam hardening artifacts

This 52-year-old man visited a local physician complaining of narrowing of the visual fields. Physical examination showed papilledema. A CT was requested to investigate the cause of the visual disturbances. In Figure 5, a tumor

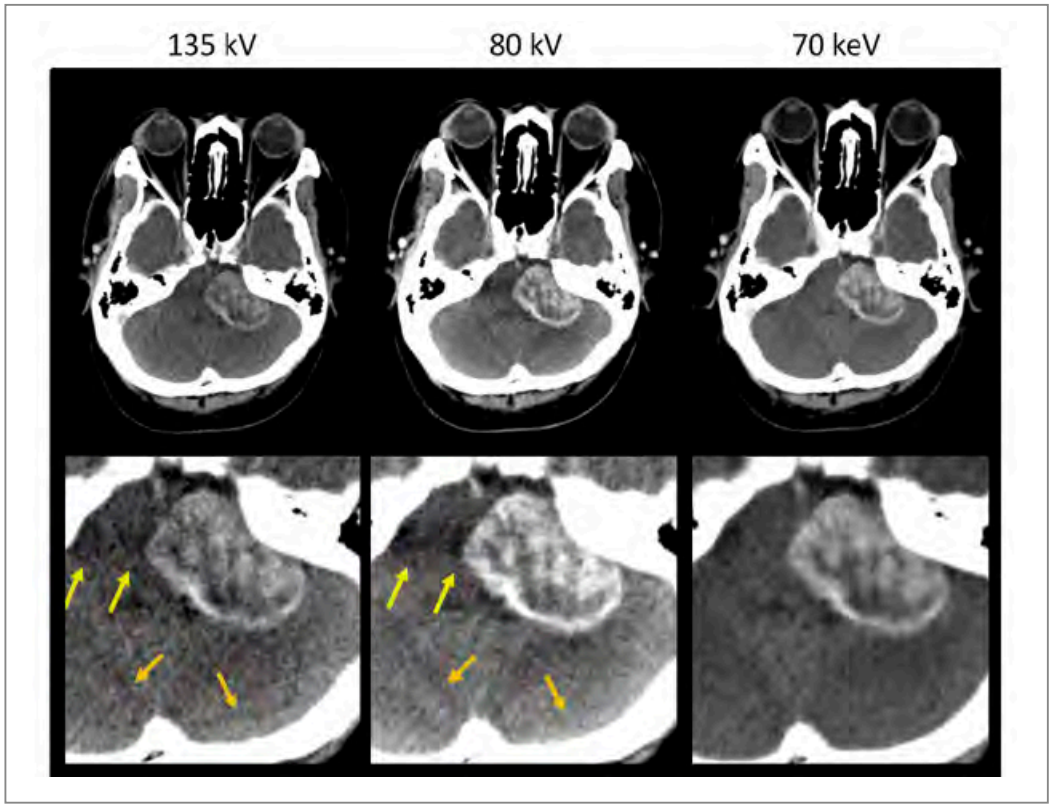


Figure 5: Comparison of beam hardening artifacts in a dual energy scan of the brain. The artifacts are reduced in the 70keV monochromatic image.

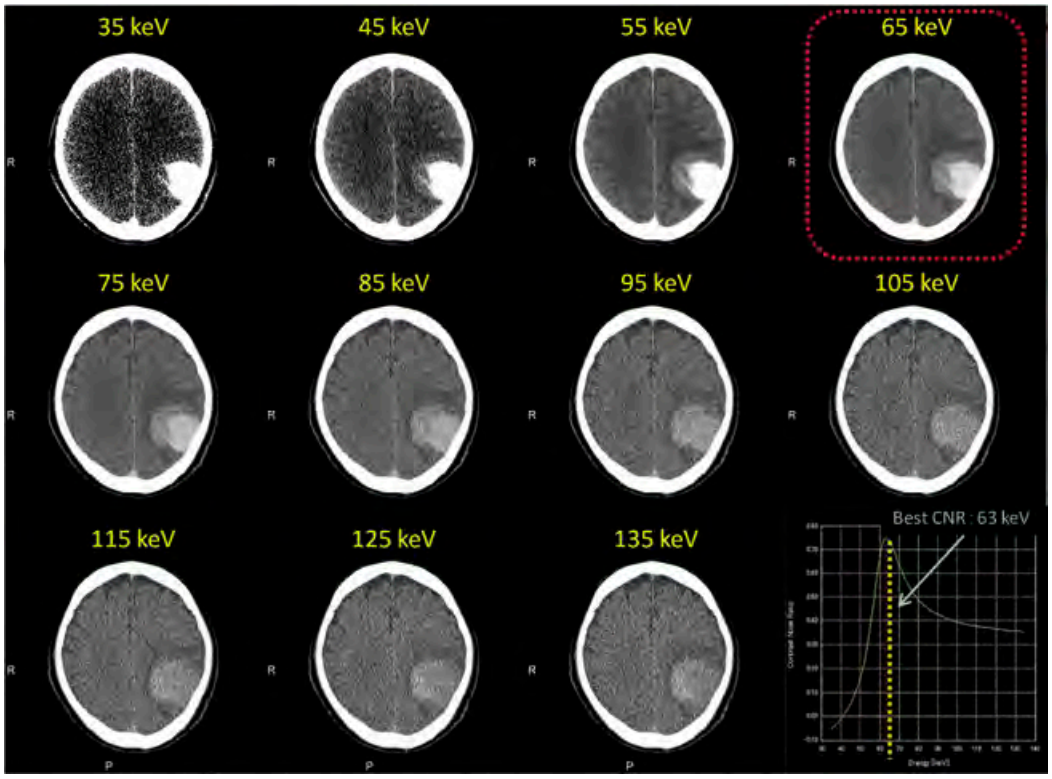


Figure 6: The best CNR image was selected from a series of monochromatic images to demonstrate the tumor and parenchyma.

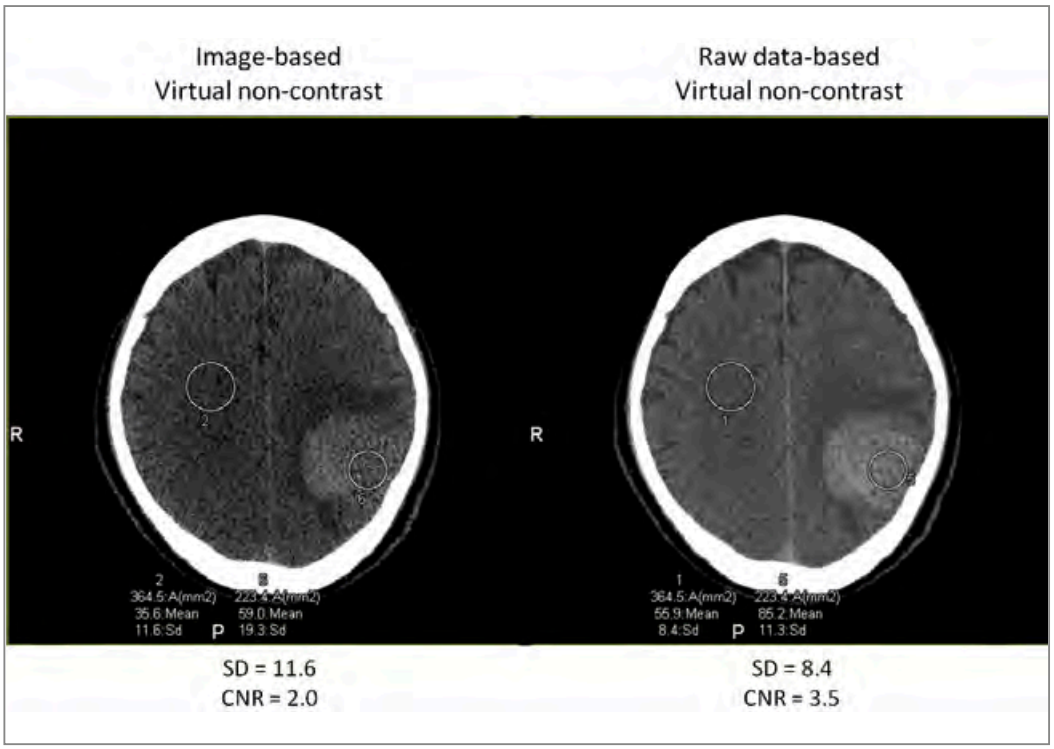


Figure 7: Comparison of virtual non-contrast images indicates that the SD and CNR are improved with raw data based analysis.

is seen at the left cerebellopontine angle, but band-like beam hardening artifacts are superimposed on the tumor at the skull base. These artifacts could be reduced by creating a monochromatic image at 70 keV while maintaining good image quality.

A tumor at the left cerebellopontine angle and hydrocephalus associated with the tumor were confirmed by MRI. The patient was referred to the neurosurgery department of our hospital.

Best CNR image

This 75-year-old man visited a local physician complaining of speech difficulties, headache, and vomiting. CT showed a metastatic tumor in the left parietal region surrounded by hemorrhage in the left parietal lobe. Monochromatic images in the range from 35 to 135 keV were created, and the image with the optimal CNR for evaluating the tumor and cerebral parenchyma was generated using the Best CNR tool. The CNR values for each keV are displayed as a graph. The Best CNR image for this patient was 63 keV (Fig 6). The patient was referred to the neurosurgery department of our hospital.

Virtual non-contrast image

The data from the same patient was then used to investigate virtual non contrast images. Figure 7 shows the comparison of image-based and raw data-based virtual non-contrast images. The noise level in the raw data-based virtual non-contrast image was lower than that in the image-based virtual non-contrast image. The SD of the raw data-based virtual non-contrast image was 8.4, which was superior to the SD of 11.6 for the image-based virtual non-contrast image. The CNR was also improved to 3.5 from 2.0.

Effective atomic number and electron density

The data from the same patient was then used to investigate effective atomic number and electron density. ROIs were placed in the bone, hemorrhage, and tumor to create effective atomic number images (Fig. 8).

The measured value for bone was 12.67, which was close to the typical value of 13.8. The measured value for hemorrhage was 6.75, which was lower than that of water (7.42). Although the measured value for the tumor was 8.69, such measurements are affected by the iodinated contrast medium and may therefore vary depending on the primary lesion or the malignancy grade of the tumor.

The measured electron density value for bone was 5.12, which was higher than that of hemorrhage (3.7) or the tumor (3.58) (Fig. 9). The electron density values for hemorrhage and the tumor were close to that of water (3.34). Electron density images can be used to determine electron density values directly from clinical images, and it may therefore be possible to create more accurate dose distribution maps for radiotherapy planning.

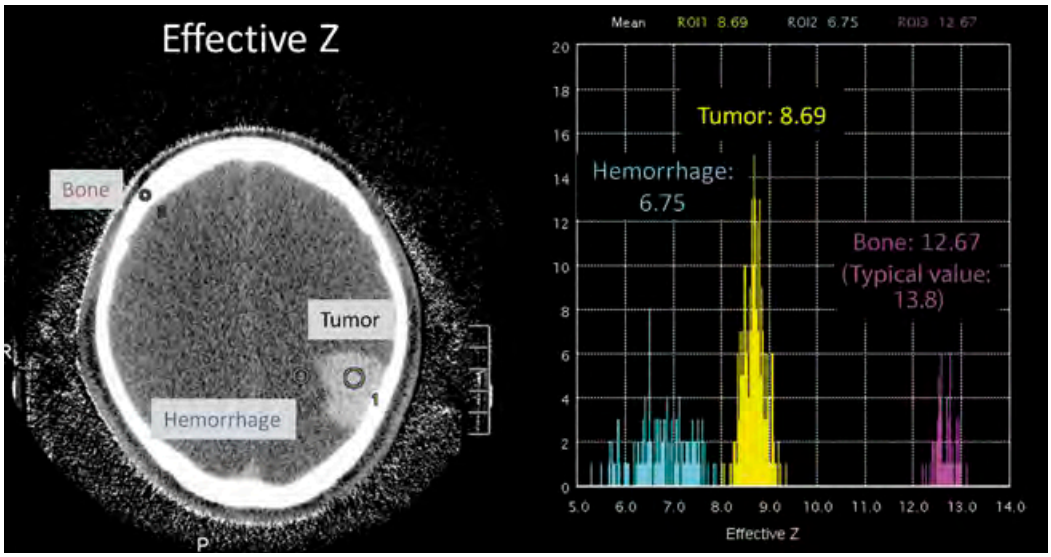


Figure 8: Effective atomic number indicates that the hemorrhage has a value lower than water (typical value:7.42). The value for tumor could indicate grade of malignancy.

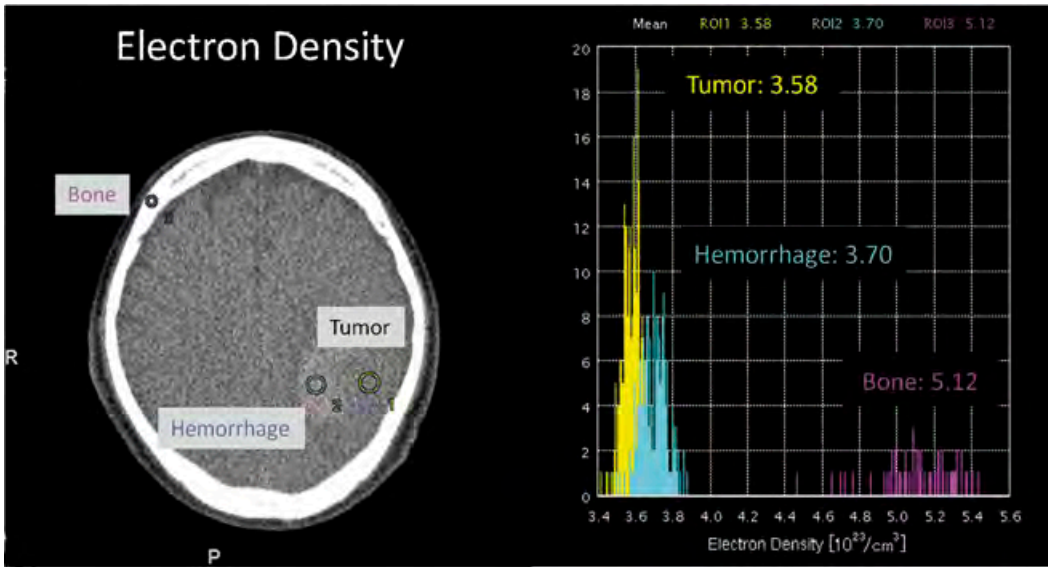


Figure 9: Electron density image could potentially be used for radiotherapy planning as the electron density values can be calculated from the clinical images.

CONCLUSION

The main advantages of dual energy technology using Aquilion ONE are that volume data can be acquired over a range of 16 cm in a single rotation, the tube current can be adjusted for each tube voltage, and AIDR 3D can be used in combination.

We have shown that monochromatic images can be used to reduce beam hardening artifacts. In addition, it is possible to use monochromatic images to measure effective atomic number and electron density which are expected to be employed in clinical practice in the near future. Effective atomic number images have the potential to be used to differentiate tumors, while electron density measurements could be used for more accurate radiotherapy planning.

We look forward to further investigations into the clinical value of raw data based dual energy analysis.

Spot Fluoro - A Novel, Promising Approach to Reduce the Dose in Interventional Procedures

Dr. Ljubisa Borota MD PhD [1], Andreas Patz [2], Takuya Sakaguchi [3]

Dr. Ljubisa Borota

The Infinix™ VF-i/BP was installed in November 2011 at the Department of Radiology, University Hospital in Uppsala, Sweden. Since then, more than 480 interventions in the cerebrospinal blood vessels and more than 1000 cerebral angiographies have been performed using the system. Additionally, more than 120 peripheral AVM were treated under the same period. The system has also been used for neurosurgical interventions,nerve root blockades and spinal myelographies.

The machine was designed to be very robust, but highly ergonomical and user-friendly. This system is characterized by superior mobility of the C-arms and unique, flexible lateral isocenter, which enables an optimal combination of biplanar working projections, regardless of the size and position of the region of interest.

The 'jewel in the crown' of the Infinix is, however, the Spot Fluoroscopy function, which is, according to Toshiba's Development Team, an innovative system, designed to save dose in interventional procedures.

Interventional procedures have become increasingly complex, which results in a significant prolongation of the fluoroscopic time during endovascular procedures. That is why, dose-saving techniques have gained more significance than ever before for patients and medical staff.

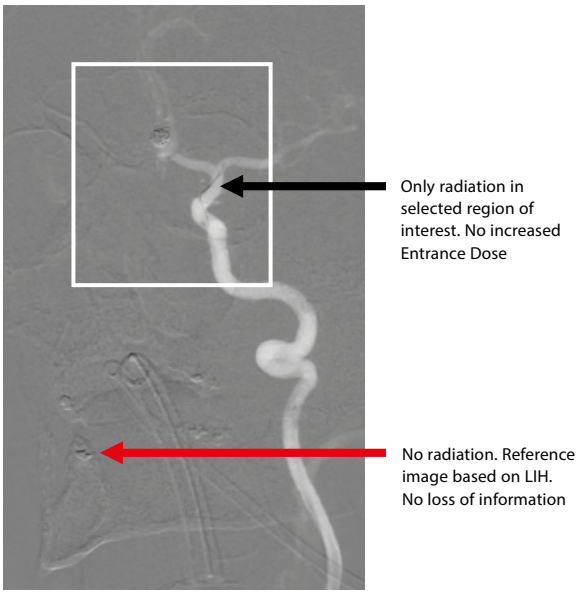
Sport Fluoroscopy is a Toshiba-patented function that is based on:

1. Asymmetric Virtual Collimation that allows a free definition of any desired collimation based on Last Image Hold.
2. Superimposition of Last Image Hold information to keep anatomical or device relevant reference information visible during Fluoroscopy.
3. Novel Automatic Brightness Control (ABC) technique that avoids a dose increase, regardless of collimation.

The core of the new function is the flexible sensing area of the ABC that adapts instantly to the predefined collimated field of view. The activation of the Spot Fluoroscopy by a simple, double mouse-click for each projection is enough to define the area of interest, required for exposure during Fluoroscopy. The localization, shape and size of this area can be redefined as many times as necessary using LIH (Last Image Hold). Since the last image hold is superimposed over the collimator blades, important anatomic landmarks are not lost during Fluoroscopy. This easy-to-use function reduces both the dose directly delivered to the patient and the scattered radiation that the staff is exposed to. Spot Fluoroscopy, coupled with the live zoom function, enable superior visualization of the target vascular structures, without requiring an increased dose.

During the summer of 2013, the Neurointerventional Team of the Uppsala University Hospital, together with Toshiba's engineers, performed large-scale measurements of various dose parameters, analyzed these and explored their impact on daily work.

Spot Fluoro advantages



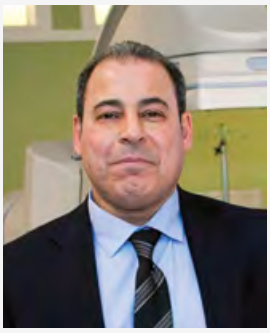
[1] *Unit of Neurointervention, Center for Imaging, University Hospital, Uppsala, Sweden*
[2] *Toshiba Medical Systems Europe BV, Zoetermeer, The Netherlands*
[3] *Toshiba Medical Systems Corporation, Otawara, Japan*

The results of the analysis showed statistically highly significant reduction of the Dose Area Product (DAP) and Dose Area Product Rate (DAP Rate) [1]. The analysis also showed that activation of the Spot Fluoro function did not lead to any prolongation of the total Fluoroscopy time or, in other words, that activation of the Spot Fluoro did not have any negative impact on daily work [1]. The image quality was assessed by two experienced neuroradiologists. It was concluded that the steep angles of working projections and massive bony structures of the skull base surrounding the target might cause marginal degradation of image quality.

Our results have clearly shown that reasonable combination of conventional Fluoroscopy and Spot Fluoroscopy can provide satisfactory image quality during neurointerventional procedure with the lowest possible dose to the patient and staff.

1. Borota L., (Uppsala, SWEDEN); Patz A. (Zoetermeer, NETHERLANDS); Sakaguchi T. (Otawara, JAPAN): Spot Fluoro – A novel innovative approach to reduce the dose in interventional Procedures, Advantages and Drawbacks, ECR, Vienna, 7 – 10 March, 2014

DR. SHALABI LEADS THE IMAGING AND FUNCTIONAL MEDICAL CENTERS (BFC) AT AKADEMISKA UNIVERSITY HOSPITAL IN UPPSALA, SWEDEN.



Dr. Shalabi - Head of department Akademiska, Uppsala University, Sweden.

When I became Head of the Centers in 2010, I put a focus on developing our Neuro-section. We changed our way of working and I have been lucky enough to be able to recruit expert competence. Our vision is to contribute to good health and good quality of life, and involves making the patients an integral part of the process.

Since 2011, we have seen extensive development of Neurointerventional Radiology at the Centre for Medical Imaging. The number of interventions performed by the Neurointerventional Team has increased tremendously. This increase corresponds with the installation of Toshiba's Infinix i-BP system. During the first phase of development in this specialist department, the Neurointerventional Team focused on acquiring the knowledge and skills necessary for treating a wide range of cerebrospinal vascular diseases. Despite the fact that the Team was understaffed, they achieved amazing results. The number of interventions increased by 300% compared to before 2010. Toshiba's team of engineers contributed significantly to fast development of The Center's neurointerventional service. It could be said that the Neurointervention Team and Toshiba's engineers 'grew up together' during this time.

Since the beginning of the 2013, the Neurointervention Team and Toshiba's Development Team worked hard on the clinical implementation of Spot Fluoroscopy - a new innovative approach for reducing dosage in interventional procedures. This represented a new phase in the development of the neurointervention at The Center. During the phase, Toshiba's Development Team played a very important role. I am proud that the first results of this common project have already been successfully demonstrated at the ABC/WIN (Anatomy Biology Clinical Correlations Working Group in Interventional Neuroradiology) Congress 2014, in Val d'Isere, France, and now, in extended form, at the ECR (European Congress of Radiology) in Vienna, Austria. I really hope that the scientific collaboration between my department and Toshiba Medical Systems will continue in the same vein and with even better scientific results.

Throughout 2013, the Neurointerventional Team has performed numerous demonstrations of the equipment for other potential customers by performing neurointerventions and complex examinations of the cerebral blood vessels, along with presentation of detailed descriptions of the system. I have received very positive feedback from this. I also hope that the future relations will continue to be based on mutual benefit and be as pleasurable as they have so far proved to be.

Toshiba's Vantage ELAN combines clinical performance with affordability and patient comfort

Toshiba's new Vantage ELAN Combines Strong Performance and Affordability

The impressive qualities of high performance, affordability and enhanced patient comfort define Toshiba's innovative new MR product.

Cost-effective and compact, the premium 1.5T MRI Vantage ELAN™ system uses the same type of magnet as other Toshiba products to achieve excellent image quality but requires a mere 23 sqm of space. With its widely recognised complete M-Power clinical application software suite and HHS (High Speed Switching) technology to facilitate the use of 16 channel coils, the Vantage ELAN manages to maintain ease of use for the operator while offering a quiet and comfortable patient experience due to Toshiba's renowned Pianissimo noise reduction technology.

This low-noise quality was one of the features of the Vantage ELAN that particularly attracted radiologist **Dr Peter Thorsten** since it is an innovation which significantly improves patient experience. When expanding his radiology practice in Güstrow, Germany, Thorsten selected Toshiba's Vantage ELAN – the first such system outside of Japan – as the "natural choice" in view of the successful relationship with the company following the installation of a Vantage Titan MRI scanner in 2010. He is particularly enthusiastic about the user interface of the Vantage ELAN and since his staff is already familiar with the Toshiba protocols, the shift to the new system will be smooth.

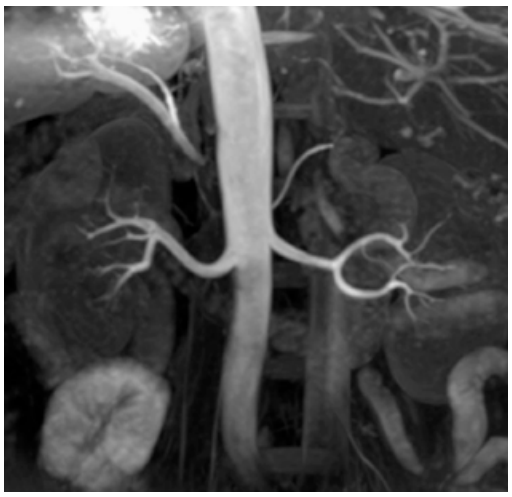
"I had the opportunity to look at the system at RSNA in Chicago and was so impressed by its performance and the coil concept that we decided to acquire it," Dr Thorsten explained. It will be used for all types of examinations from the head to the spinal column and joints. "Moreover," he added, "abdominal MRI is an important area in our office and the Toshiba sequence strategy has enabled us to specialize in MR phlebography."

As Toshiba aims to grow its market share, particularly in Europe, the company is confident that the addition of the Vantage ELAN to its MRI portfolio has created a unique opportunity within the marketplace.

Dr. Peter Torsten (third from left) from Güstrow, Germany, is particularly impressed by the comprehensive coil concept and the low-noise performance of Vantage ELAN

Alain Bertinatti, Toshiba Medical System Europe's MR Business Unit Manager, underlined that the cost pressure hospitals and healthcare systems are currently experiencing was a major consideration in the development of the new product. Faced with the decision to either compromise on its renowned image quality, design, technical innovation or unique set of features or to endeavour to deliver a high quality product at a competitive price, the company clearly opted for the latter. Bertinatti is proud to present the Vantage ELAN system which combines outstanding homogeneity and a 1.5T ultra-short zero boil-off magnet to offer excellent image quality. In addition, the system is equipped with Eco Mode technology to ensure highest energy efficiency.

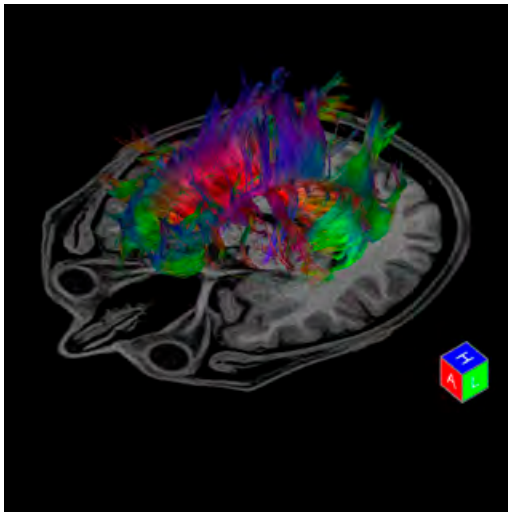
Bertinatti pointed out that all the latest innovations of Toshiba systems are available on the Vantage ELAN, including Toshiba's advanced non-contrast MRA technology, which allows exceptional vascular imaging without the use of contrast, thus reducing patient risk and at the same time being cost-effective.



Time-SLIP of renal vessels, a non-contrast-enhanced MR angio technique

Dr Isabelle Parienty-Boyer from the Radiodiagnostic and Medical Imaging Centre, Hauts-de-Seine, France, is a specialist in non-contrast renal MR angiography. She performed about 700 examinations of renal arteries in patients suffering from renal insufficiency. Since referring nephrologists often ask her to refrain from using gadolinium she works with Toshiba's Vantage MR system without contrast agents because the results are as good as the contrast-enhanced scans, sometimes even better. In her opinion Toshiba offers the best equipment for this type of examination because of the ability to use two planes, axial and coronal.

Hans Baartman, Senior Product Manager at Toshiba Medical Systems Europe, highlighted another major benefit of the Vantage ELAN: the ease and speed of installation. Since the system requires little space it can simply be integrated in the examination room. With all elements



Tractography of the brain, acquired with a DTI scan in 49 directions

An FSE PD scan acquired with a 16 element flex coil

such as ECG and recording equipment integrated it is ergonomically designed to be comfortable for the operator. Feet first imaging significantly enhances the patient experience, Baartman said, adding that Pianissimo Σ capability, integrated coils and sound suppression technology reduce the noise of the MRI environment. "There is also the option to tilt the patient's head 10 or 20 degrees in order to make the patient feel a little more comfortable. Moreover the new light design of the board helps reduce the claustrophobic feeling many patients experience," he added.

The Vantage ELAN has a 63 cm aperture with feet first imaging available for all types of examinations, except for scanning of the head and upper torso. Full angio and cardio suites are available, and the body package can be extended to include the SpineLine application offering fully automated planning of spine examinations. Together, these options enable head to toe imaging.

According to Hans Baartman, the structure and format of the Vantage ELAN optimize workflow, enhance the radiographer's options and ensure swift and efficient image acquisition and processing.

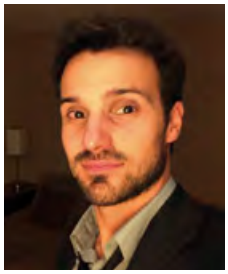
The Vantage ELAN requires a mere 23 sqm installation space

Single energy metal artifact reduction algorithm for CT evaluation of periprosthetic soft tissues: Clinical applications

Dr. Pedro Teixeira [1)], Dr. Jean-baptiste Meyer [2)], Dr. Alain Blum [3)]

Metallic hardware is commonly used in orthopedic surgery for osteosynthesis, reconstructive surgery and arthroplasty. CT is the imaging method of choice for the evaluation of the periprosthetic bone and the metal implants [1,2]. It allows the diagnosis of important post-operative complications such as prosthetic loosening, polyethylene wearing and hardware fractures. Although less frequent than bone and metal hardware complications, post-operative soft tissue lesions can occur [3]. Soft tissue complications may lead to significant disability and may necessitate specific patient management, making the diagnosis of these conditions essential. In the presence of metal however, the evaluation of the periprosthetic soft tissue is greatly hindered by metallic artifacts.

Dr. Pedro Teixeira



Dr. Jean-baptiste Meyer

Dr. Alain Blum

Soft tissue evaluation with MR imaging is also limited by the presence of metallic implants that generate chemical shift artifacts, shape changes on the periprosthetic structures and faulty fat suppression. Ultrasound, on the other hand, is not hindered by metallic artifacts. The use of this technique for post arthroplasty evaluation is, nonetheless, difficult. With ultrasound, the field-of-view is restricted, the evaluation of deep periarticular structures is difficult and post-operative soft tissue changes undermine the diagnostic performance of this method. In this context the improving the quality of the soft tissue evaluation on CT is particularly important as this method has the potential to offer a global post-operative evaluation in patients with arthroplasty.

Metal artifact reduction (MAR) on CT is no easy task. When metal is exposed to a polychromatic X-ray beam, it creates data inconsistencies between the model used by the reconstruction algorithm and the actual data. As a result beam hardening and photon starvation artifacts are generated [4]. These artifacts, which are particularly prominent when a narrow window setting is used, cannot be corrected on the image domain. Despite these difficulties MAR in CT has become increasingly more effective in the last few years.

Dual-energy monochromatic imaging for metal artifact reduction has been evaluated by various authors. However, the best results in metal artifact reduction have been obtained when projection-based algorithms applied in the raw-data domain are used alone or in association with dual-energy acquisitions [5]. In this article, the clinical application of a versatile, single-energy projection-based MAR algorithm (SEMAR) is presented.

BASIC PRINCIPLES

The MAR algorithm is raw data based and uses various steps data segmentation, forward projection and interpolation associated with stratification of tissue component [6]. The main steps of the SEMAR algorithm are summarized as follows (Fig. 1): First the raw data is forward projected to create a sinogram. In parallel the same data is reconstructed using standard filtered back projection (FBP) and the metal is segmented in the image domain. Metal-segmented data is forward projected to create a metal-only sinogram. Then this metal only sinogram is subtracted from the original sinogram and linear interpolation is used to calculate the missing data. The interpolated sinogram is reconstructed with FBP and the resulting image volume in then segmented to further exclude residual metal artifacts. The resultant data is forward projected and again linear interpolation is performed to fill in the data gaps. Finally, from this last sinogram, an image volume is reconstructed with FBP and the metal data from the first segmentation is reintroduced in the image domain.

[1-3)] CHU Nancy, France.

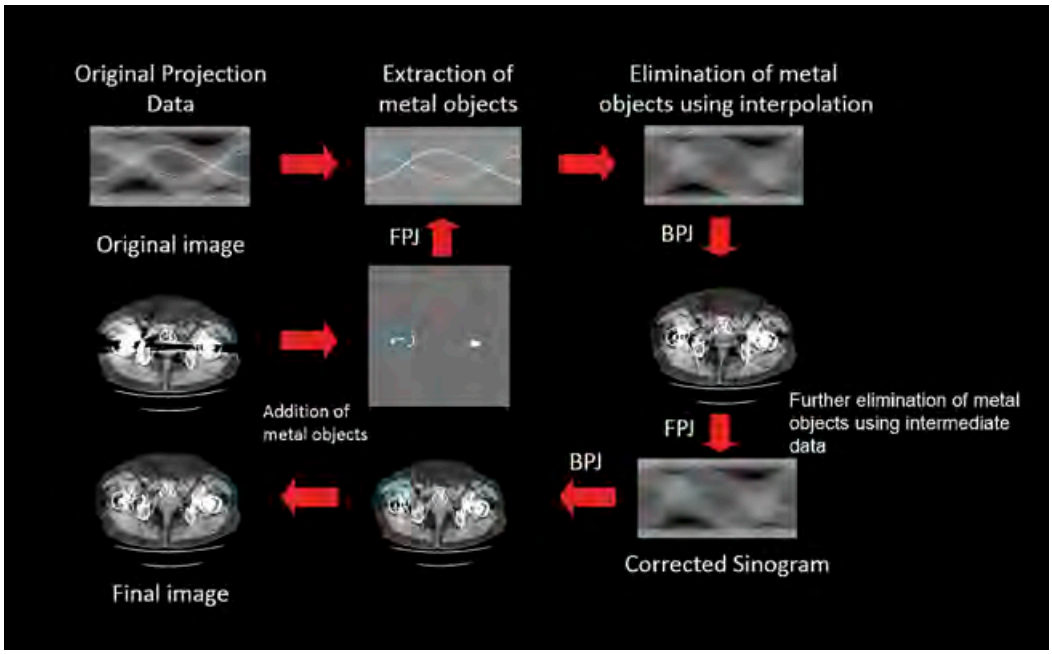


Figure 1: SEMAR Algorithm. BPJ: Back Projecten, FPJ: Forward projection

MATERIAL AND METHODS

Patients referred to our institution for the evaluation of post arthroplasty pain and discomfort were imaged with a 320 detector-row CT scanner (Aquilion ONE, Toshiba Medical Systems, Otawara, Japan). A sequential acquisition with 16 cm z-axis coverage was performed. When 16 cm was not enough to cover all the prosthesis a wide-volume acquisition was performed. Tube output parameters were adapted to the patient's body habitus and iterative reconstruction (AIDR 3D) was used in all patients. The images were further reconstructed with the SEMAR algorithm before analysis. Soft tissue structures were evaluated with a narrow window setting (400/10).

The images acquired with iterative reconstruction only were compared to those acquired with the association of iterative reconstruction and SEMAR (Figs. 2, 3).

DISCUSSION

The use of the SEMAR algorithm led to a noticeable global increase in image quality for the analysis of the periarticular soft tissue structures of the hip and shoulder. The SEMAR reconstruction increased the confidence in the

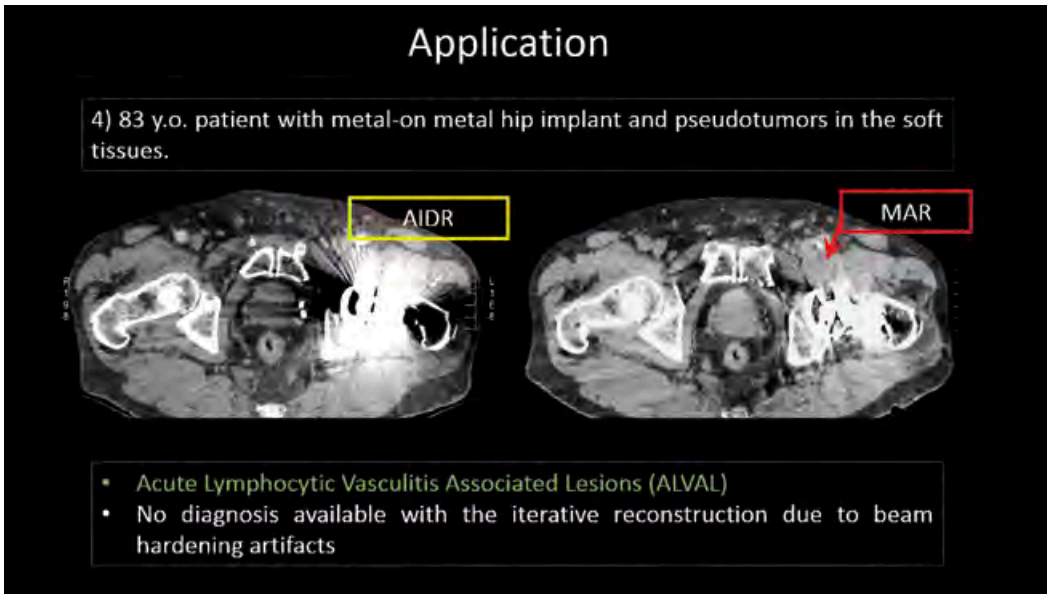


Figure 2: Left: Iterative reconstruction images of hip implants. Right: SEMAR images

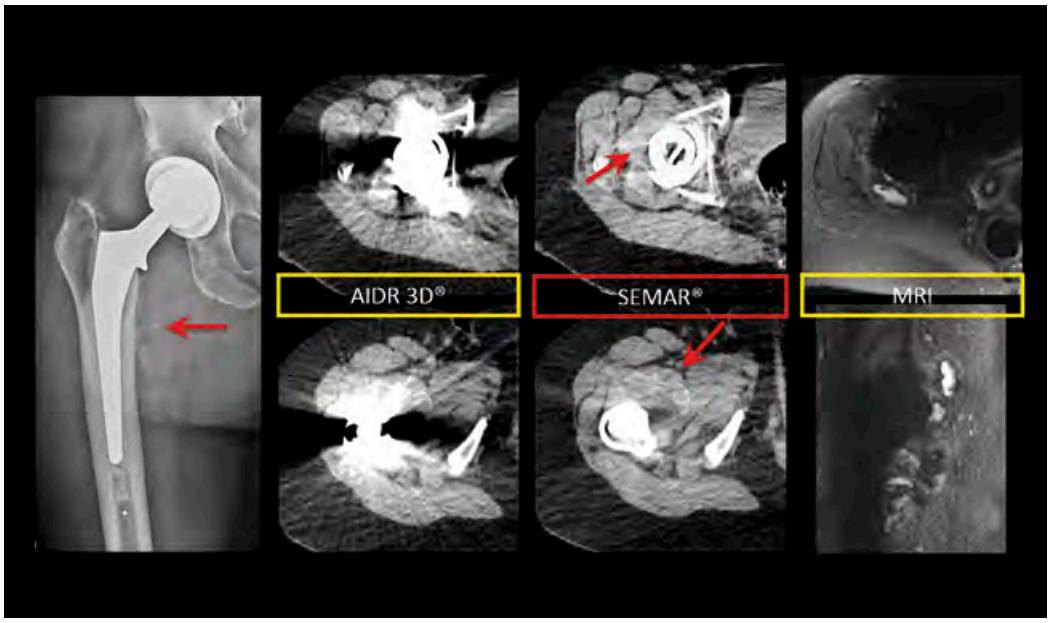


Figure 3: 68 year old female patient with painful right Metal-on-Metal THA. Left: FBP, Center: SEMAR, Right: MRI. Acquisition technique: 320 x 0.5 mm, 120 kVp, 100 mAs. Effective dose = 1.2 mSv. Note the when SEMAR is used two peri articular masses became visible (red arrows). Even with state of the art MAR MR images are still greatly hindered by metallic artifacts in this case.

identification of specific periarticular structures such as muscles, tendons, and nerves at the shoulder and the hip. Structures, such as the gluteus minimus and medius tendons, that were often completely obscured by the metallic artifacts became identifiable with good confidence. The same was seen at the rotator cuff muscle belies, that could be evaluated for post-operative for the identification of fatty atrophy after SEMAR with higher confidence. Moreover, in patients with hip prosthesis a great improvement in the visualization of the pelvic organs, especially the prostate and the bladder, was noted.

In our clinical experience, the described improvement in image quality led to an increase in the identification of periarticular masses in patients with hip prosthesis. Anomalies such as joint effusion or periarticular fluid collections could be seen with more confidence (Fig. 3). In some cases, the use of the SEMAR algorithm led to the identification of lesions completely obscured by the metal artifacts. In addition, the image quality gain using this algorithm was also noticeable when large amounts of metal were present, such as in patients with bilateral hip prosthesis.

Single energy MAR has the advantage of been more versatile than dual-energy MAR protocols. The performance of dual-energy MAR and the optimal kVp used for monochromatic reconstruction are related to the type of metal alloy of the prosthesis. Not surprisingly, there is no consensus in the literature as to the optimal post processing settings for dual-energy MAR. Single-energy MAR algorithms tend to be more versatile. SEMAR has de advantage of having a standardized application independent of the type of metallic implant. It has also the potential of been used with a low-dose acquisitions, which might be interesting for the evaluation of some patient populations.

In conclusion, SEMAR offers a significant advantage for the evaluation of the soft tissue around metallic implants compared to conventional CT reconstructions. It seems evident that this technique increases the performance of CT for the evaluation of post arthroplasty complications. In this setting, CT with SEMAR has the potential to be used as a one-stop-shop method allowing the conjoined evaluation of bone, metal and soft-tissue.

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Interview with Professor Thor Edvardsen M.D., Ph.D., Department of Cardiology at Oslo University Hospital, Rikshospitalet, Norway.

Creating New Standards in Ultrasound Cardiology

New Guidelines Incorporating 2D Wall Motion Tracking to Assess Non-ST Elevation Acute Coronary Syndrome Could Save Lives

Coronary Artery Disease (CAD) presents in a variety of forms, some of which, pose particular diagnostic challenges for specialists. Non-ST Elevation Acute Coronary Syndrome (NSTE-ACS), for example, is not evident with Electrocardiogram (ECG) examination. However, early detection and appropriate treatment are essential for these high risk patients and many lives could be saved by faster diagnosis. Advanced echocardiographic technology provides promising new options in diagnosis.

Diagnosing the somewhat elusive, but potentially life-threatening condition of NSTE-ACS has until now, presented a clinical challenge for cardiologists worldwide. CAD can present as silent ischemia, stable angina pectoris, acute coronary syndrome (ACS) or death. ACS includes unstable angina (UA), non-ST segment elevation (NSTE) and ST segment elevation myocardial infarction (STEMI). These high risk manifestations of CAD are significant causes of emergency medical care and hospitalization globally. Diagnosis is not always straightforward. An ST-elevation found in ECG usually indicates that the patient has a coronary artery occlusion and requires acute revascularization therapy. Coronary artery occlusion and/or significant coronary artery stenosis may, or may not manifest in those with NSTE-ACS - there is a great deal of variation from patient to patient. ECG examination is not sensitive enough to reliably identify some of these manifestations. Despite this, revascularization therapy is required in as many as two thirds of NSTE-ACS cases and early diagnosis and treatment improves prognosis.

A SOPHISTICATED SOLUTION

Professor Thor Edvardsen M.D., Ph.D. is one of the world's leading cardiologists. He promotes the use of advanced echocardiography techniques as a reliable diagnostic tool in the assessment of suspected NSTE-ACS patients. Using Toshiba's 2D speckle tracking technology, he advocates Wall Motion Tracking (WMT) for analyzing strain in the myocardial layers and detecting myocardial deformation - an intrinsic mechanical property that measures myocardial systolic function more directly than cavity-based echocardiographic parameters. As its potential to save lives becomes evident, Toshiba has introduced 2D WMT into all its echocardiographic systems and has organized an international training initiative to enhance knowledge about the technique.

RESEARCH WITH LIFE SAVING POTENTIAL

"The high mortality of NSTE-ACS patients has always concerned me and has driven my research into new diagnostic procedures that could save lives," remarked Professor Edvardsen. "It is vital to discover and treat significant CAD quickly and effectively. Echocardiographic tools have progressed significantly in the last 10 years and advances in 2D image resolution enable analysis of layer-specific myocardial deformation and myocardial systolic function clearly, quickly and accurately. I would like to see these techniques incorporated into global best practice guidelines for the diagnostic and treatment strategy of suspected NSTE-ACS patients, as soon as possible."

ADVANCED TECHNOLOGY

Before Toshiba developed 2D WMT, imaging techniques enabled examination of the complete thickness of the myocardial wall, without distinction between the layers of the myocardium. The left ventricular wall of the myocardium comprises three myocardial layers with the endocardial layer the most susceptible to ischemic injury. Toshiba pioneered improvements in 2D echocardiographic image resolution that enable the analysis of the different layers and with careful evaluation, can increase the diagnostic accuracy in CAD. The 2D WMT technique is currently unique to Toshiba systems. It is not offered with any other commercially available system.

"2D WMT is a semi-automated quantitative technique for assessment of cardiac function based on gray-scale images," explained professor Edvardsen. "Strain in terms of relative tissue deformation, is evaluated on a frame-by-frame basis, by tracking acoustic markers (speckles) throughout the cardiac cycle. We measure it in each Left Ventricle section by calculating the average relative deformation in longitudinal circumferential, or radial directions. Analysis of this strain analysis enables global and regional myocardial deformation to be quantified, which can help to identify NSTE-ACS patients with coronary artery occlusion, so that appropriate treatment can be started immediately."

"What I like about 2D speckle tracking is its robustness."

PROMISING RESULTS

Professor Edvardsen, together with a dedicated cardiology research group at the Oslo University Hospital, Rikshospitalet, in Norway, assessed the endocardial function of patients with significant CAD compared to those with without. They measured layer-specific strain through 2D WMT, using 2D speckle-tracking echocardiography (STE) incorporated in Toshiba's Ultrasound systems such as the Artida, Aplio and Xario. Territorial longitudinal strain (TLS) was calculated on the basis of perfusion territories of the three major coronary arteries in a 16-segment Left Ventricular (LV) model and global circumferential strain (GCS) was averaged from six circumferential LV segments in all three layers.

The eventual study, published in The Journal of the American College of Cardiology (JACC) Cardiovascular Imaging in May 2013 [1], showed that endocardial function was more affected in patients with significant CAD compared to epicardial function and ejection fraction (EF). Patients with significant CAD had worse function in all three myocardial layers assessed through TLS and GCS. Endocardial TLS was most affected. Differences in endocardial and epicardial TLS and GCS were lower in patients with significant CAD, reflecting a pronounced decrease in endocardial function.

"Since publication of this research paper, I have received significant positive interest from cardiologists from all over the world, who are eager to find out more about the results, techniques used and how to replicate them," said Professor Edvardsen. "Apart from the emerging scientific evidence of its potential to save lives, what I like

"The potential of 2D WMT to save lives is considerable."

about 2D speckle tracking is its robustness - the reproducibility is very good, the technique can be very easily trained to others and takes only minutes to incorporate into diagnostic procedures. We advise clinics to adopt the procedures and work together with hospitals and clinics across Norway to train people in the technique. "

The Cardiac Competence Team from Toshiba provides intensive support to the Cardiology Research Team of the Rikshospitalet Oslo. In addition engineers from Toshiba Medical Systems Japan also collaborate with the advanced cardiological research activities. The hospital received their Artida™ system three years ago for research purposes. Since the introduction of the speckle tracking technology Toshiba has incorporated 2D and 3D speckle tracking into its full range of echocardiographic systems.

POTENTIAL FOR POINT OF NEED DIAGNOSTICS

"A key aspect of improving prognosis is fast, effective diagnosis. Medical emergencies can arise at any time and any place and there might not always be a cardiologist available. Technology and techniques that are reliable, mobile, convenient and easy to use for other specialists can improve a patient's chances." emphasized Professor Edvardsen. "The compact size and mobility of the wide range of Toshiba systems that incorporate 2D WMT offers the potential for diagnosis in a variety of practical settings, including smaller clinics and health centers. The key to the future is in developing effective point of need devices and practices that can be used by a broader range of healthcare professionals."

GROWING INTEREST

There is an increasing interest in diagnosing the contractility of the different myocardial layers. Growing interest from cardiologists in the paper published by Professor Edvardsen and his team was confirmed with additional interest in presentation of the 2D WMT technique in NTSE-ACS by Dr. Sebastian Savari, Lead Cardiology Research Associate at Oslo University Hospital, Rikshostpitalet, Norway, at the European Cardiology Society 2013 Congress in Amsterdam, the Netherlands. Dr. Savari's presentation was delivered to a packed and appreciative audience of international cardiologists. [2]

In response to this growing interest, Toshiba has organized practical workshops in WMT for specialists. The first took place on November 2013 at Clinico San Carlos, Madrid, Spain, where leading cardiologist, Dr. Leopoldo Pérez de Isla, conducted a two-day training on the clinical impact of WMT.

Prof. Thor Edvardsen is one of the world's leading cardiologists. He received his Medical Degree (M.D.) from Haukeland University Hospital, University of Bergen, Norway and Ph.D. / Dr.Med. from the University of Oslo, Norway. Professor Edvardsen is a board-certified specialist in Internal Medicine and Cardiology and has been a senior staff member at Department of Cardiology at Oslo University Hospital, Rikshospitalet, since 2002. He became Acting Chief of the Department of Cardiology in 2012. In 2003-2004, he worked at John Hopkins Hospital, Baltimore, United States (US). Professor Edvardsen was reelected as a Board member of the European Association of Cardiovascular Imaging (EACVI) in 2012 and is now the Chair of the EACVI Scientific Documents Committee. He has more than 100 international scientific publications and 10 book chapters. He is active in clinical and experimental research in the area of myocardial function and has extensive knowledge of cardiac ultrasound, MRI, CT and hemodynamics.

GLOBAL BEST PRACTICE

Professor Edvardsen strongly believes 2D WMT should become an additional standard best practice globally.

"The evidence emerging from research is clear and positive and the potential of 2D WMT to save lives is considerable," he said. "The sooner it is incorporated into international guidelines on Assessing Non-ST Elevation Acute Coronary Syndrome the better, however, this will probably take some time to realize."

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Superiority of Lung Subtraction Above Dual Energy

W.J. van der Woude [1)]

CT Pulmonary Angiogram (CTPA) is nowadays the method to rule out pulmonary embolism (PE), by looking at filling defects in central or peripheral arteries. Small embolisms are easily being missed because of the many small arteries. Differentiation can also be hard because of partial volume effect. Distal to an embolus the lung perfusion might be disturbed. The new lung subtraction method might be able to show the reduced lung perfusion, which is almost invisible at the standard CT.

W.J. van der Woude

PULMONARY EMBOLISM

PE is displacement of thrombi from the peripheral veins, like the legs or arms, into the main artery of the lung or one of its branches. The risk of PE is increased in various situations, such as cancer and prolonged bed rest.

With CTPA it is feasible to detect this thrombi, as they show up as filling defects in central arteries or occlusion of the peripheral arteries in the lungs. Because of many small arteries and partial volume effect it can be difficult to detect smaller thrombi which results in missed emboli. Reduced lung perfusion caused by thrombi is almost infeasible with standard CTPA.

DUAL-ENERGY

In Dual Energy (DE) imaging, two peak voltages (kVps) are used to acquire two sets of images of the desired anatomic region. Comparing Hounsfield Unit (HU) differences of the two images allows differentiation of tissues. Thereby it is possible to display the local iodine concentration and detect local perfusion differences and differentiate iodine from calcium. The low- and high-energy scans are acquired in a simultaneous, sequential or interleaved way. The advantage of the technique lies in the fact that there is no motion between the series and therefore image registration is not necessary.

Several important limitations exist in the clinical application of DE. First the low kVp datasets have substantiality more noise than images acquired at higher kVp and therefore ineffective in obese patients. Second, in a dual-source system the second tube has a restriction in maximum FOV.

IODINE MAPS

The local distribution of contrast can be visualized in an Iodine Map, where the amount of local contrast is displayed as a color overlay. When there is a complete obstruction of a pulmonary artery caused by a cloth, perfusion defects are usually shown. In this setting, wedge-shaped perfusion defects are demonstrated at the subpleural portion of the corresponding lung parenchyma.

SUBTRACTION IMAGING

Besides DE there is also the possibility of using subtraction imaging. For subtraction imaging there is the need of a pre and post contrast CT. When subtracting the post

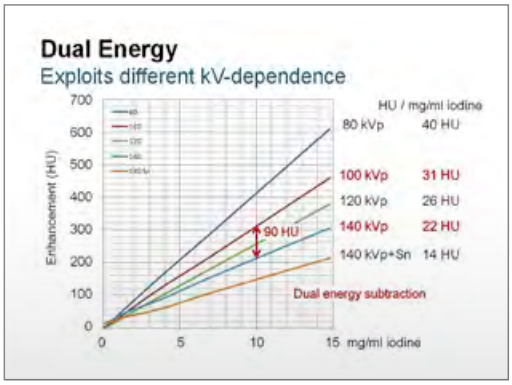

Figure 1: kVp linearity Dual Energy

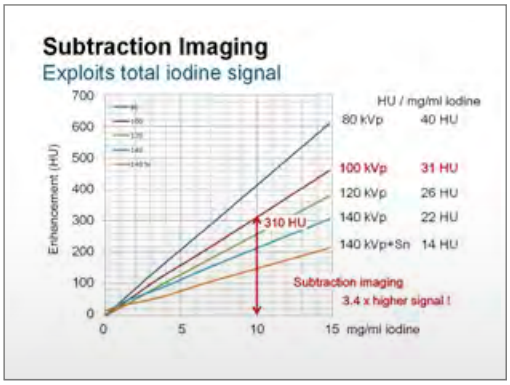

Figure 2: kVp linearity Subtraction Imaging

[1)] *Radboud University Medical Center, Nijmegen, The Netherlands*

contrast scan from the pre contrast scan a subtraction image is derived. Because of the kVp-linearity of iodine the CNR of subtraction imaging is always higher than that of DE. The amount is dependant of the kVp used. For example when scanning with 100kVp the CNR is 3.3 times higher. For identical image quality of iodine maps ten times less dose is needed for subtraction imaging.

The key challenge in subtraction imaging is the registration of pulmonary arteries. Because of pulsation, motion and difference in breathing, artefacts may arise. Together with Toshiba Medical Systems we managed to tackle this challenge and the result has less artefacts and excellent display of small vessels.

WORKFLOW

For our CTPA scans we use the Aquilion ONE ViSION Edition, which provides a fast rotation time of 0.275s and because of its new designed detector, 20% more light output can be achieved. Together with the new designed subtraction scan mode we can reduce artefacts even more. For the subtraction method settings like kVp, FOV, Reconstruction Filter and Scan Range have to be exactly the same. In the subtraction scan mode the pre and post contrast acquisitions are linked to assure that these scan conditions are equal for both scans. Besides this link of settings the S&V and ROI placement must be made before the pre contrast acquisition to have as less time as possible between both scans.

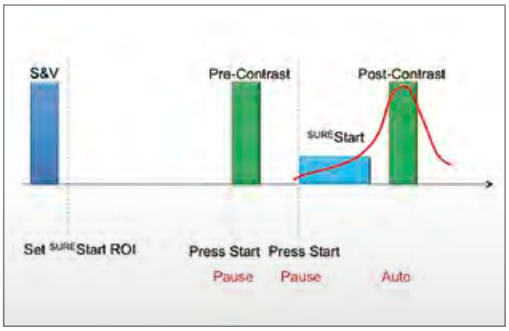

Figure 3: Idea behind new scanmode

Figure 5: Voice timing setup on scan console 1

To prevent bad enhancement caused by the valsalva manoeuvre we use voice timing. With the valsalva manoeuvre patients keep their breath while putting to much pressure. As soon as the pressure rises in the chest, blood will be forced out of the pulmonary circulation. When the pressure on the chest is released, venous blood can once more enter the chest and the heart. As a result of the manoeuvre the contrast bolus will be interrupted and bad enhancement of the pulmonary vessels will be seen. With voice timing patients get the breath hold command after a fixed time instead of reaching the set threshold in the pulmonary trunk. If patients put to much

No.	Start	Start Time	Wait	Start Pos.	End Pos.	Scan Mode
1	P	***	***	0.0	500.0	DualScano
2	A	***	***	500.0	0.0	DualScano
3	P	***	0.0	100.0	100.0	S&V
4	P		0.0	0.0	300.0	Sub-Hel
5	P	***	2.0	***	***	SureStart
6	A		0.0	0.0	300.0	Sub-Hel

Figure 4: New Subtraction Sacmode

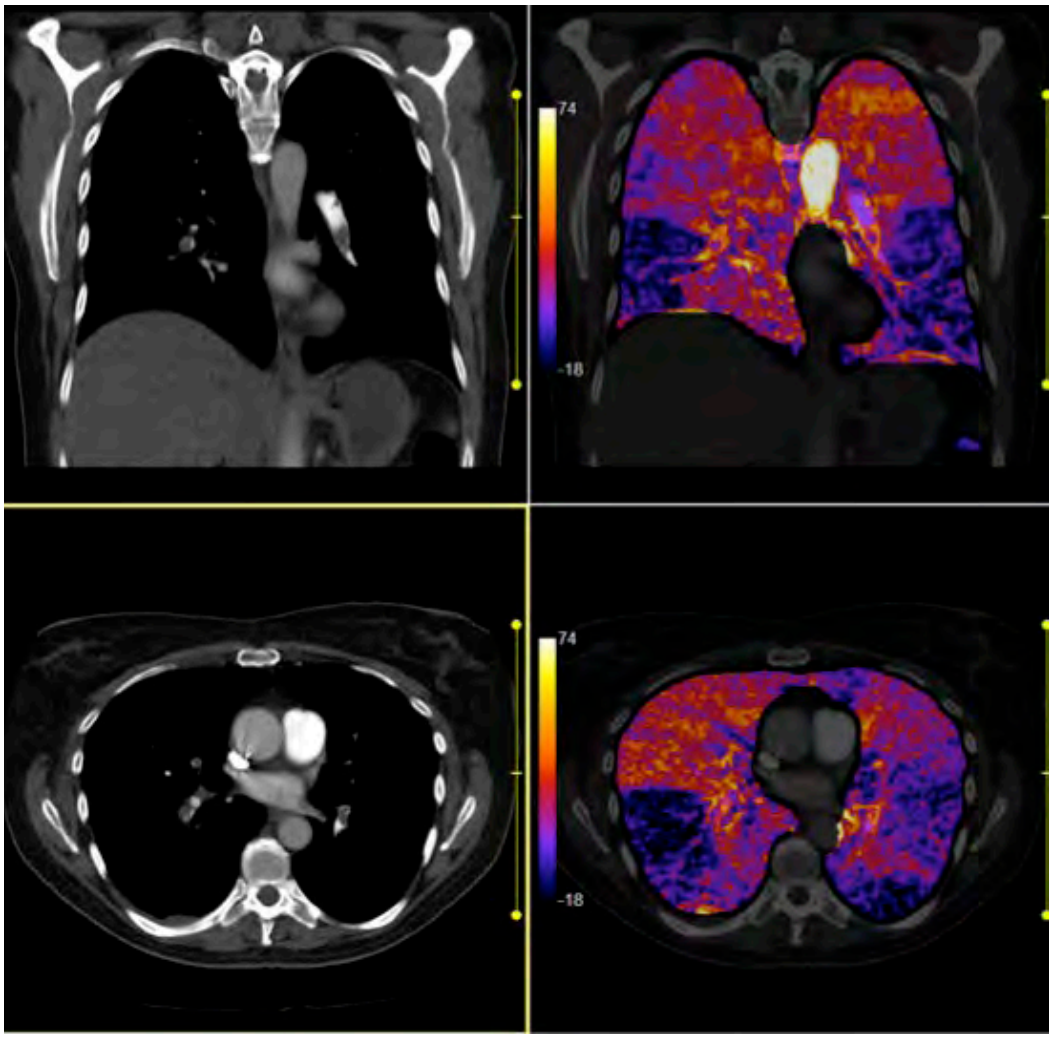

Figure 6: Axial and Coronal view of lung embolisms and corresponding perfusion defects

pressure in their breath hold this will be measured in the SUREStart and the start of the scan will be delayed till the contrast bolus recurs.

After scanning both acquisitions image data is stored on the console. On the display console both series have to be loaded in the SURESubtraction Lung, which can be found in the Clinical Applications. The application needs the user to load pre and post contrast scans and registration and color-coding gets done automatic in a short period. Color-coded images can be stored and send to PACS or any other system for reviewing.

DOSE

Because the pre contrast scan is mainly made for subtraction imaging, it can be at a very low-dose. Therefor we use a SUREExposure of SD 30 and AIDR 3D on. The post contrast is a normal CTPA scan and made with SUREExposure SD 22.5 and also with AIDR 3D on. As a result the median DLP and effective dose, for both scans, in 50 consecutive patients is 171 (2.5mSv) with a range from 84 (1.2mSv) to 815 (11.8mSv). k-factor = 0.014 mSv × (mGy×cm)-1.

OUTSIDE PE

The subtraction scan method is very helpful in patients with interstitial lung disease. In these patients subtraction can provide information about the perfusion in areas of inflammation or air trapping where perfusion could be used as a marker of disease activity.

Also for patients with Emphysema and COPD subtraction could help for the evaluation of the local perfusion and tell something about the local perfusion. The perfusion could then be related to emphysema and the COPD gold stage.

CONCLUSION

Our initial experience with lung subtraction in CTPA shows that it is an excellent tool for detecting perfusion defects. Corresponding the perfusion defects with the vessels we could improve the finding of PE, particular when situated in smaller arteries. The amount of obstruction could be used as outcome predictor. If reproduced in a large study with patient follow-up, the lung subtraction method might help to select patients who will benefit from treatment.

Violation of longitudinal strain of the left ventricular myocardium as a predictor of positive stress echocardiography results.

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Dr. V.V. Potapov

Dr. V.E. Smyalovsky

[1-7] The budget-funded healthcare facility "Clinical Diagnostic Centre", Omsk region.

Violations of longitudinal strain of the left ventricular (LV) myocardium are known as one of the earliest manifestations of systolic dysfunction, appearing when the global contractility of the heart is preserved due to compensatory increase of other types of strain (circular, radial, and torsion). To maintain a normal level of the left ventricle global contractility and pumping function parameters, sufficient reserves are needed to enable functioning of these compensation mechanisms at rest. However, during exercise or other stress these reserves may be exhausted, and the compensation will fail.

AIM

The study was aimed at comparison of the longitudinal strain at rest with the results of subsequent stress echocardiography in patients without clinical manifestations of coronary heart disease.

MATERIALS AND METHODS

The study involved 20 patients without cardiac complaints (16 men and 4 women) aged 40–50 years (mean age 43.7 ± 7.2) with a variety of nonspecific electrocardiographic (ECG) changes: extrasystole, negative T waves, etc. listed in Table 1. All patients had undergone stress ECG (bicycle ergometry or treadmill test), but for various reasons this kind of exercise was not included in the diagnostic criteria (subjective reasons, a significant blood pressure increase during the procedure, etc.). Therefore, in all 20 individuals stress echocardiography with transesophageal atrial pacing was performed. In addition to the standard study protocol with comparative visual assessment of the kinetics of the left ventricular myocardium at rest and at different stages of stimulation (120, 140, and 160 pulses per minute), the quantitative characteristics of the longitudinal and transmural myocardial strain before the exercise and at its peak were studied using 2D Speckle Tracking technology ("Artida" from Toshiba, Japan). Statistical analysis was performed on a personal computer using the Student's test criterion with the Microsoft Excel software package. Differences with $p<0.05$ were considered significant.

RESULTS

The study at rest showed no visual violations of contractility in any patient, and the ejection fraction ranged from 58% to 71% (64.2 ± 4.7%). Transmural (both local and global) deformation indices of the LV myocardium were normal. However, the evaluation of longitudinal strain before stress testing identified two subgroups: 9 patients with the range of all indices of global and local longitudinal strain from -15% to -18% (the first subgroup), and 11 patients (the second subgroup) with violations of local longitudinal strain in some segments (-7% to -12%), without any effect on the overall local myocardial contractility at rest. Visual examination of the working report of stress echocardiography at a maximum frequency of stimulation showed some zones of hypokinesia in all patients from the second group, accompanied by a significant expansion of the regions of longitudinal strain violation, and also by reduction of transmural strain in segments

Table 1: The distribution of electrocardiographic changes at rest in the patients examined.

Electrocardiographic signs	Number of patients
Atrial extrasystole	8
Ventricular extrasystole	7
Negative T waves	8
Uncertain ST-segment depression	4

Figure 1: Quantitative parameters of global and local circular strain before stress-testing in a patient with a positive test result. All the indicators of strain are within the normal range.

Figure 2: Longitudinal strain of LV endocardial layer before the stimulation. Localized areas of the left ventricle with a pronounced decrease in this indicator are coloured blue.

Figure 3: Transmural deformation of the LV endocardial layer before the stimulation. All areas of the left ventricle reflecting the normal indices of overall contraction are coloured yellow.

Figure 4: Longitudinal strain of LV endocardial layer at the peak of stimulation. Areas of the left ventricle with a pronounced decrease in this indicator are coloured blue.

with hypokinesia. The ejection fraction was significantly decreased in both groups compared to the baseline ($p = 0.036$ and $p = 0.0005$, respectively), but the second subgroup with a positive result showed its decrease below normal values, to 44.3 ± 2.1% at the peak of stimulation.

CONCLUSION

Thus, stress echocardiography with transesophageal atrial pacing showed a positive result in all patients with local violations of longitudinal strain before the exercise, reflecting the functional state of the subendocardial layer of the LV myocardium, i.e. revealed chronotropic exercise-induced ischemic response in the LV. Therefore, the detection of local violations of the longitudinal function of the LV myocardium, even without their impact on the overall motility, can be regarded in stress testing as a predictor of a diagnostically significant reduction in contractility.

Figure 5: Transmural myocardial deformation of the LV endocardial layer at the peak of stimulation. Areas of the left ventricle with a pronounced decrease in contractility are coloured dark brown.

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Equipped for Success

Interview with Ilse Vejborg (Head of Radiology)
and Johnny Madelung (Chief Radiographer)

Supporting Specialist Strengths

Interview with Dr. Klaus Kofoed (Cardiologist Clinical Associate Professor) and
Karen Damgaard (Consultant Radiologist in Pediatric Radiology)

Delivering Excellence through Partnership in Denmark

Interview with Bjarne Alhøj (Managing Director of TOSHSCAN Denmark)

Equipped for Success

The Radiology Department at Rigshospitalet Copenhagen in Denmark is an emerging global center of excellence and comprises nearly 300 staff, carries out more than 160,000 examinations per year it has significant capabilities in both specialist clinical practice and pioneering research and is gaining increasing recognition as a global center of excellence. The Department has been equipped to the highest standards with a large proportion of its systems made by Toshiba. Ilse Vejborg, Head of Radiology, and Johnny Madelung, Chief Radiographer, lead the Department and have been largely responsible for driving its long term development into a world class diagnostics centre, together with highly specialised teams. VISIONS spoke to Ilse and Johnny to find out exactly how this has been achieved.

Inside the Rigshospitalet, the spacious reception and route to the Radiology Department, where the VISIONS interviews are scheduled, have a calm, relaxed atmosphere, which gives little indication that this is one of Denmark's largest, busiest and most prestigious specialized hospitals, with 1200 beds, more than 100 departments and functions, over 50 professional specialties and 8000 staff. Using resourceful and clever spatial design, including use of underground room for housing medical equipment, the hospital has created a welcoming and friendly environment, in which, cutting-edge diagnostics, treatment, patient care, research and medical education are carried out efficiently and effectively.

THE HEART OF HEALTHCARE

At the heart of the Radiology Department, literally and figuratively, is the staff. In the center of the Department's main isle, hangs a large board featuring the staff – their photographs, names, specialisms and job title. It includes each and every employee at the facility. There are nearly 300 profiles on display, arranged within five specialist sectors, including Body Imaging, Breast Imaging, Neuro radiology, Ultrasound and Vascular Intervention. Alongside their own specialisms, the Department's staff also played a major role in developing a brand new trauma center that has recently been opened at the hospital. Its highly skilled and highly motivated individuals, working together within a non-hierarchical structure, enable this facility to achieve formidable results in clinical practice and research. The Department's cutting-edge equipment, which includes 15 ultrasound-, 11 CT- and five MRIs scanners. Most of the CT systems are made by Toshiba, and it has its own dedicated TOSHSCAN Denmark service engineer onsite, along with ongoing support from staff at TOSHSCAN Denmark, Toshiba Europe and Toshiba Japan. This ensures it deliver the high quality imaging necessary for accurate diagnosis, treatment and research into the specialist cases that the hospital receives.

Ilse Vejborg, was recently appointed as the new Head of the Radiology Department. She has worked at the hospital for more than 24 years. She described the team dynamic, which enables the Department to achieve the high standards that it has become reknown for.

"This is the biggest radiology department in Denmark, 295 highly specialized staff – You might think it would be a challenge to simply remember who everyone working here is, and yet the sheer size of the department offers more of a benefit than challenging to manage!" she remarked. "This is because our staff are clearly organized according to specialized sector, which gives everyone unique opportunities to utilize and develop their expertise. I rely completely on, and trust in, their specialist skills. All our specialists are very experienced and 100% engaged in delivering a very high level of service. We have cultivated a strong sense of teamwork, despite the large size of the department, and there are no barriers between different staff. We all work together to solve problems and get procedures done, and this is a nice feeling."

Johnny Madelung, Chief Radiographer, originally joined the department 26 years ago and has been working in his current post for the last 12 years.

"The Department is a really nice place to work," he said. "Specialists and other staff work together well in its open and communicative environment. We have a multinational team, with Danish, English, Swedish, or Norwegian languages spoken. This positive environment has been cultivated over many years. This doesn't, of course, just happen easily by itself. The Department is well-equipped with state-of-the-art systems and spatially arranged to optimize the environment for patient and staff alike. The positive reputation of our great department attracts radiographers from all over the world, who are 'queuing up' to work here.

Ilse Vejborg – Head of Department of Radiology

Before being appointed as Head of the Radiology Department at Rigshospitalet Copenhagen in (month) 2013, Ilse was Acting Head for one year. Alongside her new role, she still leads the mammography screening program for the Copenhagen, in which, 200,000 women each year are screened as a preventative care measure against breast cancer. The screening program operates across five hospitals in the region. Her expertise in breast imaging, gathered over more than 18 years, also extends to on national and international levels. Ilse is the President of the Danish Society of Breast Imaging, she is a member of the Danish national Steering Committee on breast cancer Imaging and of the council in the Danish Breast Cancer Cooperative Group (DBCG) and the Danish National Steering Committee of Quality Assurance in Mammography Screening (DKMS). In addition, she is one of three medical experts on breast imaging on The Danish National Complaint Board. Ilse develops national clinical guidelines on both diagnosis of breast cancer and mammography screening. She also supervises PhD students at the department of Radiology. She is an associate editor of BMC Cancer and has authored 59 scientific papers and contributed to textbooks on breast examination as well as organized and presented in international and national training courses, scientific congresses and seminars and media broadcasts.

AN EYE ON TECHNOLOGY

Alongside his clinical role, Johnny has driven the introduction of pioneering new equipment into the Department for many years.

"One of my main priorities is exploring new advances in technology to ensure that our staff has the right equipment to deliver high quality results," he said."I travel a lot to other hospitals worldwide, where I gather insight into the management of radiology departments in different countries. I bring back home any useful pieces of information on new products and practices. This is part of our two-way, information-sharing relationship with the other hospitals, in which, they are also invited back to learn about our procedures and equipment. Most radiology departments are more than happy to participate in this type of exchange and want to showcase the best of their knowledge to help and inspire others."

EXPERT-LED DECISION-MAKING

As the Department expands in both clinical and research capabilities, and technological possibilities advance, acquiring new imaging equipment is a frequent priority for the team. From initial concept to final purchase, the decision-making process at the Radiology Department involves several specialists, hospital authorities and also the purchasing department.

"Normally, a working group comprising of physicians and radiographers, and regulatory medical technicians is formed to specify exactly what is required, thoroughly investigate the options available and their costs, and develop a tender for purchase," explained Johnny. "It is the staff who ultimately led the decision-making process, according to what functionality they require in systems, because they will work daily with the equipment acquired. We keep all those involved in the decision-making process updated on the latest developments in the equipment marketplace."

"One of my main priorities is exploring new advances in technology."

Johnny is also head of the Department's environmental group, which aims to ensure that health, safety, comfort and environmentally sustainability are incorporated inherently in the workplace. These factors are also increasingly important considerations in the decision-making process for purchasing new equipment.

While functionality principally drives the choice of equipment at the hospital, the eventual purchase is, of course, subject to financial approval and appropriate purchasing processes.

"We wanted to have the Toshiba machine as it was the best," added Ilse. "Of course, advanced technology has a price tag, but we wanted our staff to have the tools to help them excel, so we demonstrated the value of the system to our purchasing staff really specifying exactly what it offered to justify the expense."

Service is also a key element in choosing systems.

"The first CT scanner that we bought from Toshiba, eight years ago, already provided a very exciting option,"

remarked Johnny, "We had heard of it before, but didn't initially know very much about it. When we explored the option, we could clearly see that the scanner's capabilities were way beyond the capabilities of other scanners. Toshiba was, and still is, one step ahead of the other scanners. It offered the exciting option of upgrading from using our single slice system to Toshiba's new Aquilion 64-multislice CT system. The big issue for us, however, was what would be the arrangement for service from a Japanese manufacturer. Bjarne Alhøj, Managing Director of TOSHSCAN Denmark, our Toshiba representative in Denmark, assured us that the requested service would be provided. So we purchased it and have been delighted with the system, its capabilities, performance, maintenance and service ever since."

The Department now has three Aquilion 64-multislice CT scanners, one Aquilion ONE™ 640 slice Dynamic Volume CT scanner, two Aquilion ONE™ /ViSION Edition 640-slice Dynamic Volume CT scanners, one Aquilion™ LB 16-slice Sliding Gantry CT scanner in the NeuroSurgery Department, two Aquilion LB 32-slice Sliding Gantry scanners in the new Trauma Center and one Infinix™ VF-I Angiosystem. For the last year, a full-time TOSHSCAN Denmark service engineer has been located at the hospital to assist with any technical issues.

ENHANCED CAPABILITIES

With the majority of the Department's CT systems now comprised of Toshiba technology, the capabilities of the five specialist sectors have advanced and the throughput of the department has increased. Having high quality systems has contributed towards increasing the hospital's patient throughput from 15,000 examinations per year in 2001 to 55.000 per year in 2013.

The staff particularly welcomed the enhanced capabilities offered by their first Toshiba's Aquilion 64 multislice CT scanner, and the enhancements offered by Toshiba's equipment ever since.

"The 64-slice CT scanner was a breakthrough at the time!'" exclaimed Johnny." Other scanners featured this, but it was astonishing. The quality of images that we could achieve with it couldn't be compared to anything we'd had before. It has now become our workhorse and we have since purchased a new 640 slice system, with which, we are still exploring capabilities, but also provide superior quality images. All our systems are in constant use in the Department."

"The dose reduction possibilities offered with Toshiba equipment are marvelous."

"We work to improve the quality of our work and make images that are better and better each day," added Ilse. "The applications that staff can make are very good. The dose reduction possibilities offered with Toshiba equipment are marvelous and are continuously improving. The best becomes even better. With the Aquilion 640-multislice, we perform a wider range of perfusion imaging and improve the assessment and adjustment of oncology treatment regimes. We also carry out guided scans of the whole liver in one section and guided ablation needle biopsies. For pediatric imaging, the shorter time required for scanning and dose reduction is ideal."

Through the partnership with TOSHSCAN Denmark, the Department receives regular software upgrades, which ensure that even their older Toshiba systems can be further optimized.

Johnny Madelung – Chief Radiographer

Johnny Madelung joined the Radiology Department in 1985 and was appointed Chief Radiographer in 2001. Johnny is an expert in imaging technology and has also been requested to equip and set up several Radiology Departments in other hospitals in Denmark.

Ilse Vejborg and Johnny Madelung in front of one of the two Aquilion LB 32-slice Sliding Gantry CT scanners at the World Class Trauma Center at Rigshospitalet.

WORLD CLASS TRAUMA CENTER

The latest Toshiba systems to be installed at the Department were two Aquilion LB 32-slice Sliding Gantry CT scanners, the first to be installed in Europe, which provides key imaging capabilities to the Rigshospitalet's brand new Trauma Center.

"The new Trauma Center is being equipped as a Level I facility and will be the only one in a public hospital outside the United States," explained Ilse. "It has been a challenge to develop the CT system for this facility, but TOSHSCAN Denmark and Toshiba have provided dedicated support and a unique solution that is now operational - A big achievement that matches our expectations and ambitions exactly."

SERVICE MAKES ALL THE DIFFERENCE

TOSHSCAN Denmark has collaborated with the Radiology Department for the last eight years and has provided dedicated support on many levels. As well as working with TOSHSCAN Denmark's resident service engineer, the Radiology Team work together regularly with Toshiba experts in both Europe and Japan.

"TOSHSCAN Denmark and Toshiba's collaboration is very important to us," said Ilse."All our staff know the TOSHSCAN and Toshiba Teams and they are considered 'part of the family' here. With so much of our equipment from Toshiba, we particularly benefit from the TOSHSCAN Denmark service engineer, who is based here. There is always someone knowledgeable on-hand to help us. Both organizations 'speak our specialist language'. With our capabilities increasing due to the possibilities with our systems and our Department's planned development, this will continue to be important in the future. TOSHSCAN Denmark is a customer-driven, well-organized company, who really listen to any issues, even if we have special issues and consult Toshiba to jointly resolve any issues."

FORGING A PROMISING FUTURE

The Radiology Department is planning for further growth and as trusted and effective partners, TOSHSCAN Denmark and Toshiba are seen as important allies in future developments.

"We are already working with TOSHSCAN Denmark and Toshiba on several research and development projects, but we hope is carry out more scientific work on the Aquilion ONE /ViSION Edition Dynamic Volume CT scanner using perfusion techniques," explained Johnny. "We are also expanding our building and creating a new, strengthened specialist sector in neurological and orthopedic imaging, which will eventually require new equipment "

Many specialists at the Department, including Ilse, also play a role in contributing to the development of national and even international imaging guidelines and best practices for their specialist area.

"Our partnership with TOSHSCAN Denmark and Toshiba's high quality systems and innovative technology help us to provide the best to our patients," concluded Ilse. "In the future, we will treat even more patients from all over the country and we will be able to treat even more patients with expansion, both in terms of our geographical scope and indications. At the core of this will be further development of our imaging capabilities."

Supporting Specialist Strengths

Amongst the 295-strong Radiology Department at the Rigshospitalet Copenhagen are three professors, 35 senior consultants, 12 consultants, nine PhD. students and 20 physicians in specialist training. Organized into five specialist departments in Body Imaging, Breast Imaging, Neuro radiology, Ultrasound and Vascular Intervention, they collectively deliver world class diagnostic results in both clinical practice and research. VISIONS explored the new Trauma Center and met with Klaus Kofoed, (M.D., PhD., DMSc.) Cardiologist Clinical Associate Professor, and Karen Damgaard (M.D., DMSc.), Consultant Radiologist in Pediatric Radiology, to find out more about the specialist work carried out at the hospital and how partnership with TOSHSCAN Denmark and Toshiba benefits it.

Equipped with a large proportion of imaging systems from Toshiba, the specialists at the Radiology Department have access to a wide range of options with dedicated machines for specialist diagnosis and treatment, as well as research.

EXCELLING IN EMERGENCY CARE

The Risghospitalet's new Trauma Center is a brand new facility to diagnose and treat injuries in adults and children sustained through accident and emergency. On completion, it will be equipped equivalent to Trauma Level I US standards and will be the only facility of this level in a public hospital outside the United States (US). It will be used to treat up to 12,000 serious trauma cases per year, including 1,000 seriously injured, 450 acutely ill and 250 burns patients. The Radiology Department led development of the Center, and key radiologists from various specialisms form a key part of the operational team.

Seconds count in Trauma care. Extremely speedy expert diagnosis and treatment, as well as minimal patient movement during examination and treatment are vital. To transport patients to the Trauma Center efficiently and easily, the Rigshospitalet has its own helipad, located on the roof above the facility and a dedicated elevator. Once inside the Center, many specialists may be required to examine the patient immediately and simultaneously, so it has been specially designed with ease of movement, continual observation, and workflow efficiency in mind. All equipment for diagnosis and treatment is located for optimal convenience in the same area.

Critical in the Trauma Center are two Toshiba Aquilion LB 32-slice Sliding Gantry CT scanners, the first system of its kind to be installed in Europe. TOSHSCAN Denmark and Toshiba provided the concept and planning for the installation in close collaboration with the Radiology Department and the Trauma Center.

"We didn't think this type of tailored solution would be possible, but TOSCHAN Denmark and Toshiba developed the proposal and successfully installed the systems," said Ilse Vejborg, Head of the Radiology Department. "It has been a challenge to develop the CT system for this facility, but through dedicated support our unique solution is now operational. This is a big achievement. The systems provides key functionality in the new suite, which will enable us to save lives."

PIONEERING ADVANCES IN CARDIOLOGY

Klaus Kofoed trained as a cardiologist at the Rigshospitalet and worked in close contact with the Radiology Department after obtaining his PhD. in 2005. He was appointed to introduce Cardiac CT at the Cardiology Department. Since then, Klaus has pioneered new ways of exploring the heart with CT examinations alongside his clinical responsibilities, and has helped raised the profile of the Radiology Department work's in the global cardiology spotlight. His inspiration comes from finding new techniques with potential to advance clinical practice and his work now comprises of a large proportion of research.

"When I started working at Rigshospitalet, I recognized the potential for CT examination in cardiology, but did not know a great deal about the technicalities involved in radiography," he explained. "Thanks to the supportive research environment here, the extensive knowledge of the Radiology Department staff, the well-defined culture of mutual respect for each discipline, the acquisition of advanced systems, such as Toshiba's Aquilion 64-multi-slice CT scanner and the Aquilion ONE 640 slice Dynamic Volume CT, and the cooperation with research and development specialists at TOSHSCAN Denmark and Toshiba, I have had the freedom to explore the potential of this possibility."

The Department acquired its first Toshiba Aquilion 64-multislice CT system - made possible by a grant from the John and Birhte Meyer foundation - for dedicated research purposes in 2007.

"With the acquisition of the 64-slice CT scanner, we were able to start really building the department," said Klaus. "It was initially just me, one radiographer and one PhD. student. CT had been explored in the context of cardiology since 2000, so we were not the very first to investigate its benefits, but when our small team published the very first Danish thesis on cardiac CT, others researching this field quickly realized that we were serious about this approach and could offer a valuable contribution to global advances in this field."

Adding an Aquilion ONE 640 slice Dynamic Volume CT scanner in 2009 - made possible by a grant from the danish foundation A.P. Møller og Hustru Chastine Mc-Kinney Møllers Fond til almene Formaal - meant the research activities of the department could be expanded and opened the doors to joining global randomized trials, which Klaus insists are a top priority in exploring if new procedures have potential as valuable additions to clinical best practice. Klaus's team has grown exponentially and now includes five PhD. Students and ten medical students.

GLOBAL RESEARCH PLATFORMS

After a short period of time, the team were invited to participate in the Coronary Artery Evaluation Using 320-Row Multidetector CT Angiography (CORE320 trial) – The first prospective, multicenter study to examine the diagnostic accuracy of CT for assessing blockages in blood vessels and determining which of those blood vessels may be preventing the heart from getting adequate blood supply. The study, which was sponsored by Toshiba Medical Systems Corporation, assessed the diagnostic performance of combined non-invasive CT coronary angiography (CTA) and myocardial perfusion (CTP), as compared to traditional assessment of flow-limiting stenosis by means of SPECT-MPI and invasive coronary angiography (ICA). The results of the trial, which were presented at the European Society of Cardiology (ESC) annual congress in 2012, found that combined CTA and CTP with 320-detector row CT allows accurate identification of flow-limiting lesions requiring revascularization.

"We were delighted to be a part of the CORE 320 trial, with a significant number of patients from the Rigshospitalet Copenhagen," said Klaus. "We were able to do so because of the unique abilities of Aquilion ONE™, the dynamic volume CT system used in CORE320, which acquires the entire heart in a single temporally uniform volume and permits accurate myocardial perfusion analysis. The perfusion technique developed for Aquilion ONE™ provides perfusion images at the lowest possible radiation dose when AIDR 3D, iterative reconstruction, is applied."

The team has already concluded a randomized, controlled trial study into cardiac CT guided treatment strategy in patients with recent acute-onset chest pain. The results of the Cardiac CT in the treatment of acute Chest pain (CATCH) study were published in the Journal of Cardiology in July 2013. They concluded that Coronary CTA may be used successfully in a subset of patients.

Dr. Klaus Kofoed

A second study organized by the team – the CATCH 2 study - which started in October 2013, will investigate the effectiveness of CT with perfusion techniques in the treatment of acute chest pain.

"Both research projects clearly focus on exploring the effectiveness of techniques and how they can be translated into improved outcomes for patients," emphasized Klaus. "'We aim to carry out large scale clinical trials that illustrate better outcome, or benefits in important parameters in healthcare, because we believe that the advanced technology we are using can improve healthcare in all senses of the word."

"We were delighted to be a part of the CORE 320 trial."

OTHER RESEARCH PRIORITIES

An important element of utilizing diagnostic imaging equipment in cardiology, as most other specialist areas, is not only creating accurate images, but obtaining comprehendible results quickly. The team is working together closely with TOSHSCAN Denmark and Toshiba to explore the possibilities with Vitrea® software - Vital Imaging's advanced visualization solution that creates 2D and 3D images of human anatomy from CT and MRI image data.
"Fantastic images are very interesting, but if they are not accessible within a very short space of time, they are of little use in clinical practice, particularly in cardiology when minutes count in saving lives," said Klaus. "Our equipment also needs to be user-friendly and easy to work with in both clinical practice and research. Vitrea® is the best emerging system at this time. It offers flexibility and versatility. We are working hard with Vital's US R&D technicians to test and improve specific features, but the system has already expanded our options so much. It is really amazing."

Klaus believes that key developments in improving software will enable a greater range of staff to carry out critical diagnostics and that this will contribute to better healthcare.

The team also constantly explores new possibilities in other specialisms with the dedicated systems that they use.

Dr. Karen Damgaard

"We are lucky to have dedicated equipment for our research and so we explore all that can be done with the equipment, carrying out as much basic scientific research as possible," said Klaus. "Alongside the benefits for cardiac research, we often notice great potential for using the systems for other areas, such as oncology. We aim to extract as much information as we can from our skilled staff and advanced resources to maximize the opportunities. It could be many years before healthcare providers see the full implications of this, but this does not discourage us. We are hoping to expand this functionality even further in the future."

"Pediatric CT can now be carried out largely without the need for anesthesia."

SHARING FINDINGS GLOBALLY

Klaus's team has hosted a number of high-level, international workshops with the support of Toshiba and TOSHSCAN Denmark. They provide a chance to promote the new techniques they have pioneered, demonstrate the capabilities of Toshiba technology and raise the profile of the hospital internationally. The basic and advanced courses, also offer opportunities to gather feedback, ideas and experience from other specialists. In October 2013, the seminar on CT Myocardial Perfusion performed on 2nd generation 320 Row Detector CT attracted 80 participants, and following its success, two more courses have been already scheduled for 2014.

CHANGING PRACTICES

Klaus firmly believes that another major advance in the future will be in integrating imaging equipment into the cardiology treatment suite.

"This would change the practice of cardiology and enable many more lives to be saved," he remarked.

CREATING NEW POSSIBILITIES IN PEDIATRICS

Karen Damgaard, Consultant Radiologist, has led the Rigshospitalet's pediatric diagnostics program since 1989. Amongst other developments in this growing area of medicine, access to the Radiology Department's Toshiba Aquilion ONE VISION 640 slice Dynamic Volume CT scanner has created new possibilities for clinical practice and research.

"Some of the features of the system, such as the speed of examination, low dose and physical suitability of the equipment make it an excellent tool for working with children, and a very good way to avoid many of the clinical problems in this patient sector posed by MRI," she remarked.

With the system, the radiographers no longer have to rely on anesthetics for pediatric patients. Previously, they would frequently examine children that had been prepared for anesthesia. The children would have a needle inserted in their arms and would often require sedation. The anesthesia department would be on standby, on certain allocated days, in case required.

"When the system arrived, it was marvelous," continued Karen, "Pediatric CT can now be carried out largely without the need for anesthesia, because it is fast, efficient and creates high quality, artifact-free images, just by talking to the young patients and relaxing them. We have used the system to perform pediatric cerebral-, trauma-CT and chest-CTs."

NEW EXAMINATIONS

In pediatric pulmonary examinations, the system has enabled visualization of lung structure and air trapping by volume investigations trough spirometri guided CT performed by a dedicated research group from the Danish ChILD Center, Pediatric Pulmonary Service, Rigshospitalet- and the department has now replaced conventional HRCT with spirometri guided CT in children with cystic fibrosis.

"This gives a true state of respiration and is particularly important in many long term situations - such as examining children with congenital lung diseases, where it is important to make the CT in exactly the same manner from year to year, to find any progression in disease of the bronchial system," she explained. "Radiographers from the pediatric team have visited and are working together with Great Ormond Street Childrens Hospital in London to further explore the technique."

"Ten years ago, the media created a negative image of CT in pediatrics that we now know is incorrect," she continued. "The advantages in pediatrics in terms of reduced cost, enhanced efficiency, increased safety, reduced dosage and complications make it ideal for this increasingly important specialism. Systems like Toshiba's advance the clinical and practical possibilities to a new level and I would advocate for the use of CT in pediatrics at any time when detailed imaging is indicated."

CLEAR BENEFITS

Through its long term partnership with TOSHSCAN Denmark and Toshiba and effective strategy that utilizes Toshiba's advanced imaging technology in an optimum clinical and research environment, the Rigshopitalet Copenhagen is better equipped to meet the inevitable challenges of advancing medicine and delivering specialized diagnostics and patient care.

Delivering Excellence through Partnership in Denmark

TOSHSCAN Denmark, the well-known face of Toshiba in Denmark, provides a full range of imaging products and service to the Danish market. Established 13 years ago in response to demand for Toshiba's systems in the country, TOSHSCAN Denmark has developed a robust business within the technophile Danish healthcare landscape. Epitomizing Toshiba's core values of dedicated partnership, high quality and innovative solutions and service, the organization is highly regarded across the country. VISIONS talked to Bjarne Alhøj, Managing Director of TOSHSCAN Denmark, to find out more about why excellence and partnership are such key ingredients in success.

A STORY OF SUCCESS

Bjarne has led TOSHSCAN Denmark since 2001. He joined the organization with a burning ambition to make Toshiba's pioneering technology widely available to public hospitals and private clinics in Denmark. He built the organization from scratch, using a focused, modular approach – a strategy to consolidate growth, modality by modality, eventually encompassing them all to ensure solid development. TOSHSCAN Denmark's initial focus was on Toshiba's CT and Ultrasound capabilities, because Bjarne felt its offer in this was particularly strong and addressed the greatest immediate needs within the Danish market. X-Ray was later added as an additional focus.

"I studied medical engineering and worked as a healthcare engineer before joining TOSHSCAN Denmark. Throughout my career, I worked closely with Toshiba, knew how high quality their products were and was familiar with Toshiba's background, the stability of the company and its products," he explained. "I also knew that many Danish healthcare specialists had recognized the same qualities and wanted to purchase Toshiba's scanners, however, at the time, they weren't available here. When I was offered the position of Managing Director of the new TOSHSCAN Denmark organization, it was the perfect opportunity to build a dedicated Toshiba organization in Denmark and bring Toshiba's products to the specialists that appreciated and wanted them."

Providing a supportive and professional service alongside Toshiba's high quality products and technology, TOSHSCAN Denmark has many satisfied customers nationally and has also enabled many Danish specialists contribute to the global medical imaging technology platform, by engaging them in open, two-way partnerships, for example, in R&D. This is particularly true of the Rigshospitalet Copenhagen in Denmark's capital city - a large, specialized hospital with significant capabilities. Toshiba systems and long term support from TOSHSCAN Denmark has helped equip the radiology department to the highest standards and help it emerge as a center of global excellence.

"One of my very first priorities was to support the prestigious Rigshospitalet Copenhagen, which at the time, were using just a few Toshiba ultrasound systems at the hospital. My ultimate goal was to supply Toshiba technology in all modalities, because I knew this could help the Radiology Team realize their ambitions," he continued. "When we first approached the Team, they were impressed by Toshiba's products, but had concerns that service would be provided from Toshiba headquarters in Japan, which, of course, would have been impractical. I believe that both high quality products and equally high quality support in optimizing their application are the most vital aspects of our work. Therefore, we provided the hospital with dedicated local service and have since supplied the majority of the department's CT solutions, including, most recently, those for the hospital's new Trauma Center – the first in world to be equipped with two CT systems set within a gantry that moves over the patient on the surgery table"

Because of the sheer number of Toshiba systems that the department now has, TOSHSCAN Denmark has a dedicated service engineer located onsite for maintenance of the systems.

PRESTIGIOUS PARTNERSHIP

TOSHSCAN Denmark's relationship with the Rigshospitalet quickly evolved into a truly two-way partnership. Danish specialists are globally renowned for their interest in innovation and what technology can offer, as well as their professionalism. With its strong active focus on research and medical education, alongside clinical practice, the hospital provides a prime example of how Toshiba's strategic priority to incorporate 'The Voice of the Customer' helps advance products and service.

Bjarne Alhøj

"We listen intently to all our customers and even involve many of them in evaluating new systems and software, incorporating their feedback into Toshiba's R&D activities," explained Bjarne. "Quite often, feedback from customers is implemented into Toshiba's technology. We worked closely together with the Rigshopsitalet to develop the unique CT system - incorporating two Toshiba Aquilion LB 32 slice Sliding Gantry CT scanners - that we created for the hospital's new Trauma Center, and the Radiology Department is exploring software, such as research into the latest Vitrea developments. In addition, specialists at the hospital host international CT workshops on new techniques jointly organized between TOSHSCAN, Toshiba and the Radiology Department."

Bjarne insists that the key to Toshiba and TOSHSCAN Denmark's success in collaborations is strict specificity about the scope of the cooperation, open communication and planning, which leads to better productivity and lasting relationships:

"Everyone at TOSHSCAN Denmark is well known by everybody at the Radiology Department of the Rigshospitalet, particular our onsite service engineer, who is regarded as a member of the hospital's staff" he says. "And the Radiology Team work together regularly with Toshiba R&D experts in both Europe and Japan. Since I have been dealing with Toshiba for more than 25 years, I know the organization very well and have been friends for years with many Toshiba colleagues. For me that's also very important.Good quality, long term relationships are an essential in this business."

ELEGANT SOLUTIONS

Partnership at this level enables the inevitable challenges of advancing medicine and delivering specialized diagnostics and patient care to be overcome. Equipping the

"We listen intently to all our customers."

Rigshospitalet's new Trauma Center presented such a big challenge. The hospital has created a Level I Trauma Center – the first public facility of this standard outside the United States (US). However, the specialists weren't entirely sure how to progress their plans. TOSHSCAN Denmark and Toshiba provided the idea to install two CT large bore scanners both enabled to move from and to the fixed couch, so patients are not moved during the scanning and/or treatment. The Radiology Department didn't think this was possible, but TOSHSCAN Denmark and Toshiba further developed the proposal and made a plan to successfully install the systems.

"It took a while to develop the installation for the Trauma Center at the hospital, with many challenges along the way, but we have provided an elegant solution, the likes of which I have never seen beforein my career," remarked Bjarne. "Its development has been made possible by people collaborating well together."

TAILORED APPROACH

Identifying which customers could potentially benefit from Toshiba's offer is an important sales focus. Daily cooperation with key customers is not always easy, but is vital to build a framework for future business together. TOSHSCAN Denmark considers all its customers unique and considers quality service as that focusing only on promoting products that can add value to individual customer's needs.

"TOSHSCAN Denmark is known as a company that is dedicated to supporting its customers," said Bjarne."We supply all modalities, but focus on each individual customer's needs and finding the right solutions for each client. We do not press if a customer is satisfied with equipment from another vendorand fully respect a customer's decision in choosing equipment. Too many companies try to sell their whole palette of products, when sometimes, it may not be required."

DISCOVERING NEW POSSIBILITIES

Denmark has a strong and well–established research culture. Danish customers generally have much experience with research and development and want to be at the forefront of developments. Denmark provides a structured research environment because individual patients can be followed for many years due to its excellent national healthcare record-keeping system. In addition, Danish healthcare authorities are supportive of good scientific research. In association with the University of

Copenhagen and the Danish University of Technology, the Radiology Department at the Rigshospitalet Copenhagen has a strong active research program and has some dedicated research equipment within its resources.

Bjarne has also found that Danish customers are particularly interested to get the most possible from new developments and optimize the use of equipment. The versatility and advanced capabilities of Toshiba's systems mean that customers themselves may find new opportunities in clinical practice and research that had not been previously explored. For example, the Rigshospitalet Copenhagen, have discovered that Toshiba systems can support outstanding CT Perfusion studies.

"Sometimes, it is the customer, who discovers new applications for our systems, because Toshiba's technology has so many facets that even our own developers may not be completely aware of the full capabilities," explained Bjarne. "When these offer benefits for patients they create new research and development avenues for the company.Toshiba provides support to selected specialists for larger scale research to explore promising new techniques in some cases."

DISSEMINATING KNOWLEDGE

Rigshospitalet Copenhagen has hosted a number of high-level, international CT workshops with the support of Toshiba and TOSHSCAN Denmark. Attended by specialists from all over the world, they provide a chance for physicians to promote new techniques, demonstrate the capabilities of Toshiba technology and raise the profile of the hospital internationally.The courses also create opportunities to gather feedback, ideas and experience from other specialists and users.Most recently, the Rigshospitalet's seminar on Advanced Myocardial CT Perfusion performed on 2nd generation 320 Row Detector CT, run by Dr. Klaus Kofoed, Cardiologist at Rigshospitalet.

MEETING THE CHALLENGES OF CHANGE

While the specialist consultants at Rigshospitalet Copenhagen are convinced of the capabilities of Toshiba systems and work closely with TOSHSCAN Denmark, they are not the only ones involved in TOSHSCAN Denmark's partnerships.

"We also work closely with purchasing departments at our customers because they are an integral part of the decision-making team in Denmark," said Bjarne. "Toshiba technology offers many new exciting clinical and research options, but of course, this has a price.We keep both clinicians and purchasers informed of what technology is coming up and what it costs."

Denmark's healthcare system includes an increasing proportion of governmental national tenders, in which certain equipment is purchased for hospitals across the country. Over the next six years, it will focus on the development of six new 'super hospitals' - located in each of the five regions in Denmark and incorporating a full range of medical specialization. The system is also being revised to put patients firmly at the center of care, which will result in better care, but also drives changes for healthcare providers.

"TOSHSCAN Denmark and Toshiba are geared to meet the challenges of change head on,"' said Bjarne. "We must meet the increasing demands on equipment, but also continue to develop new things.While we are advancing fast, there are still huge opportunities to improve the speed and accuracy of diagnosis and help patients become healthy again through exploring new areas that continually emerge in our industry. One of the biggest challenges is defining how to structure healthcare in the best way and how we can improve our support, so that the benefits to hospitals and patients are optimized. We sell solutions, not just equipment - TOSHIBA Made for Life."

ENVIRONMENTAL PRIORITIES

In line with growing focus on sustainability and the environment, TOSHSCAN Denmark implements Toshiba's environmental policy, as well as its own.

"In addition to the environmental benefits offered by Toshiba's systems, such as energy-saving features, reduced packaging and other eco-standards, TOSHSCAN Denmark strives to contribute to making our business more sustainable in any way that we can," said Bjarne. "We want to ensure that our staff and our customers and their patients have safe, healthy and environmentally-compatible surroundings. This is also a personal goal for me."

AWARD-WINNING

Guided by Bjarne's careful strategic approach and delivering on TOSHSCAN Denmark's substantial promise of high quality support and service in providing Toshiba's innovative diagnostic solutions, the organization has established an unparalleled reputation in Denmark with customers and the medical imaging industry alike. Its long term clients include prestigious world class medical establishments, like the Rigshospitalet Copenhagen. The organization has recently been recognized with Toshiba Medical Systems Europe awards for Outstanding Performance 2012 DABO Region North and Outstanding CT Performance 2012.

BRIGHT FUTURE

Now comprising a strong, modern organization, TOSHSCAN Denmark continues to grow year by year. In 2012, it became Denmark's market leader in CT systems.

"Further growth is important, but we must ensure that this is stable and only grow in a way that creates a solid, sustainable organization that will be around to support its clients, their patients and contribute to the global Toshiba organization well into the future," concluded Bjarne.

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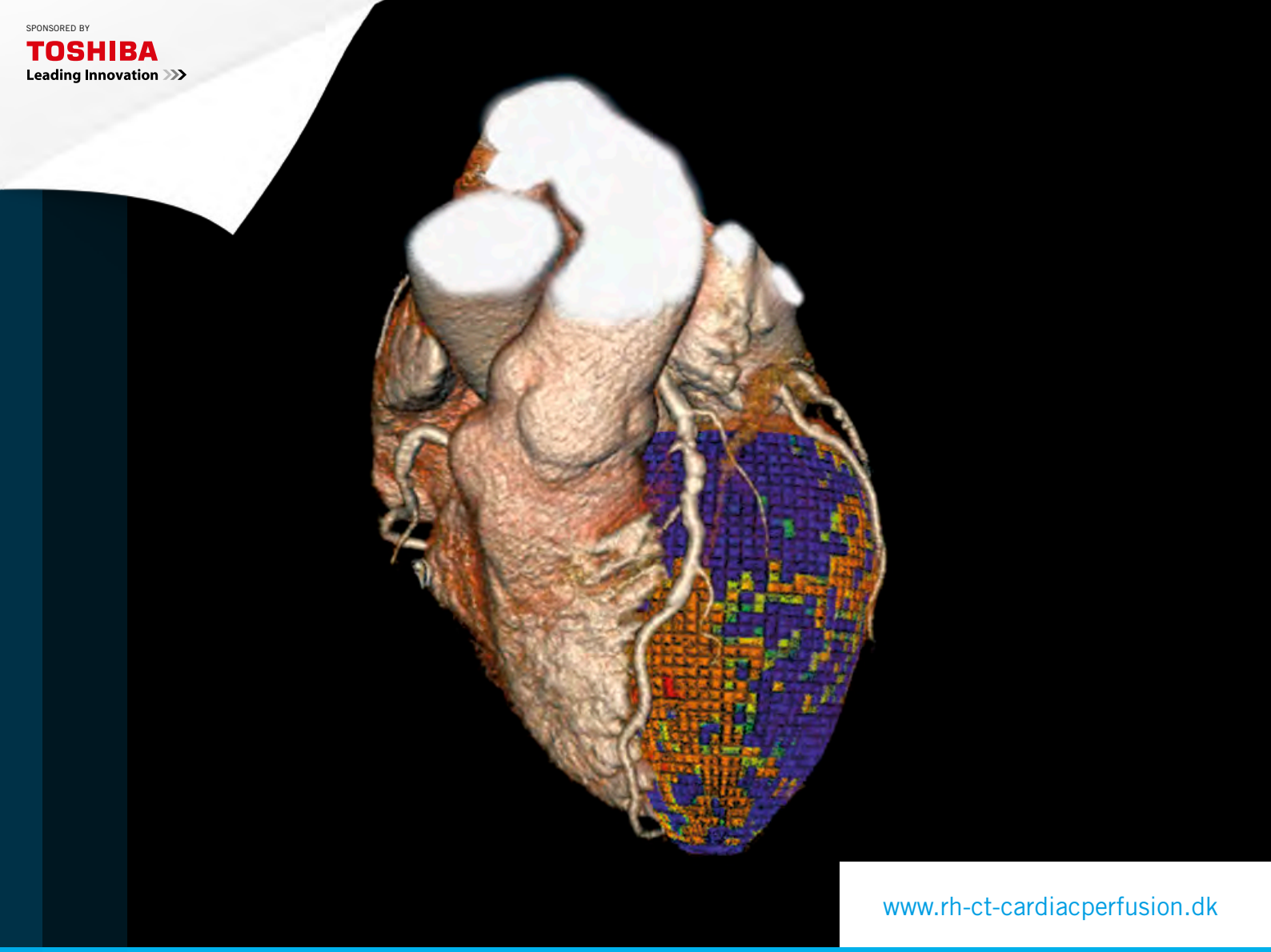

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Rigshospitalet

Department of Radiology and Cardiology
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Subtraction CTA of the brain detects cerebral aneurysms

Dr. W. Chen [1)], Dr. W. Xing [2)], Dr. Y. Peng [3)], Dr. Z. He [4)], Dr. C. Wang [5)], Dr. Q. Wang [6)]

We show in this short article that we can detect cerebral aneurysms using 320-row detector CT in conjunction with a powerful subtraction technique.

Dr. W. Chen

Dr. W. Xing

A cerebral aneurysm, also referred to as brain aneurysm is a weak swollen spot on the wall of a brain artery very much like a thin balloon on an inner tube. Over time, the blood flow within the artery pounds against the thinned portion of the wall and aneurysms form silently from wear and tear on the arteries.

As the artery wall becomes gradually thinner from the dilation, the blood flow causes the weakened wall to swell outward. This pressure may cause the aneurysm to rupture and allow blood to escape into the space around the brain. A ruptured brain aneurysm commonly requires advanced surgical treatment.

MATERIAL AND METHODS

282 patients with suspected cerebral aneurysms were enrolled in the study. The volumetric subtraction CTA was performed on Aquilion ONE™ covering the whole brain without moving the table. A low dose non contrast volume acquisition was performed followed by a post contrast volumetric acquisition. SURESubtraction was performed to remove the bone from the post contrast images. Each patient underwent invasive DSA which served as the reference standard. A total of 239 aneurysms in 198 patients (70.2%) were detected by DSA.

RESULTS

The results showed that the accuracy of non-subtracted volumetric CTA was lower than for subtracted CTA, especially for aneurysms adjacent to bone tissue. The difference between subtracted CTA and invasive DSA was not significant (p=0.5), however the difference between non subtracted CTA and invasive DSA was considered significant (p=0.031).

	Sens	Spec	Acc
Non subtracted CTA	96.7%	100%	97.5%
Subtracted CTA	99.2%	100%	99.4%

The advantage of CTA over invasive DSA is that CTA is non-invasive, fast, widely available and easy to perform. The added advantage of subtraction is in identifying aneurysms in vessels that are adjacent to bone, such as the internal carotid arteries (Figure 1). These can be easily missed on non-subtracted images. One limitation of subtracted images is that plaque and calcification of the aneurysm are not displayed. Despite these limitations we have been using subtracted CTA as the first-line imaging modality to screen patients presenting with symptoms suspicious of cerebral aneurysms.

CONCLUSION

Subtracted DSA of the brain could replace invasive angiography for the detection of cerebral aneurysms.

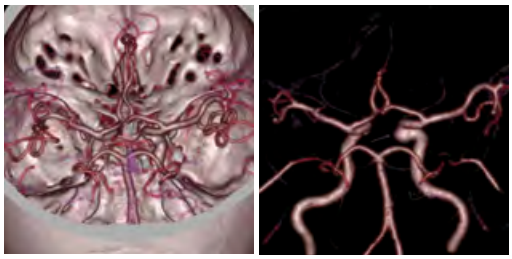

Figure 1: Example of a patient with an aneurysm of the internal carotid artery. The aneurysm is easy to evaluate in the subtracted image.

The results were published in Radiology:
Chen W, Xing W, Peng Y, He Z, Wang C, Wang Q,
Cerebral Aneurysms: Accuracy of 320-Detector Row Non-subtracted and Subtracted Volumetric CT Angiography for Diagnosis, Radiology, 2013, Sep 5

[1-6)] *Third Affiliated Hospital of Suzhou University, China*

Diagnosis and treatment of primary sarcoma of the liver

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Histiocytic sarcoma is a rare tumor, representing less than 1% of all the hematopoietic and lymphoid neoplasms. An isolated hepatic lesion is even a rarer manifestation of malignant histiocytosis. The problem with diagnosis of primary histiocytic sarcoma of the liver lies in the absence of specific diagnostic criteria for this condition when patients are examined by echography, computed tomography and magnetic resonance imaging. A non-distinctive clinical features characteristic for any primary tumor of the liver and the absence of a uniform diagnostic algorithm makes the choice of treatment tactics difficult, which may have an unfavorable impact on the disease prognosis.

The approximate worldwide incidence of primary malignant liver tumors (PMLT) does not exceed 0.7% of all oncologic conditions [1]. In Russia in 2012, the annual incidence rate of primary malignant tumors of the liver and intrahepatic bile ducts was 4.6 per 100 000 population [2]. Of all PMLT, hepatocellular carcinoma comprises 58-76%, cholangiocellular carcinoma - about 7-35%, and hepatoblastoma is found in 1-6% of adult population. Sarcomas are rarer forms of PMLT. According to LCSGJ (1997), the analysis of materials obtained from 649 medical centers revealed only 11 cases of liver sarcoma per 13381 cases of hepatocellular carcinoma [3].

Studies from the medical literature contain references to the undifferentiated embryonal sarcoma (ES) of the liver. According to some authors, starting from 1978 there are over 200 case reports dealing with the ES of the liver [4-7]. Angiosarcoma is the other relatively common form of PMLT [8]. Medical literature contains occasional case reports of primary carcinosarcoma and liposarcoma of the liver [9-11]. Histiocytic sarcoma is the rarest form of PMLT, and we were unable to find any references to the primary histiocytic sarcoma of the liver in the medical databases available to date.

CASE REPORT

In this report, we present the case of a patient with histiocytic sarcoma of the liver.

Female patient, 24 years old, presented to the Moscow Herzen oncological research institute from a local outpatient clinic where an ultrasound examination (US) revealed a mass in the left lobe of the liver.

She has no relevant family history regarding tumors. No evidence of chronic viral or non-viral hepatitis was obtained. The levels of tumor markers including the Alpha-Fetoprotein (AFP) are within normal. Gastroscopy and colonoscopy showed negative findings. U/S examination of the hepatic segment II revealed a non-homogeneous mass sized 60 x 55 x 53 mm, with uneven contours, showing pathologic vascularization, causing deformation of the visceral surface of the left hepatic lobe and located adjacent to the stomach along the lesser curvature wall. The results of U/S examination allowed us to suspect the presence of a primary tumor of the liver or metastatic tumor with unknown primary site. In order to conduct a differential diagnosis and evaluate the dissemination of the tumor process the patient underwent a thoracic and abdominal computed tomography (CT) scan with intravenous contrast enhancement and gadoxetic acid-enhanced (Gd-EOB-DTPA) magnetic resonance imaging (MRI) of the liver.

Patient underwent MRI on 1.5T MR imaging with a flexible 4-channel body coil and the Vantage Titan™ system (Toshiba). MRI protocol that we used – Dynamic 3D FatSAT. TR 5.5ms, TE 2.5ms, Flip angle 12°, NAQ 1.0, MTX 206x206, Slice thick/slice Gap 8mm/0mm, FOV 320, Image technique FFE3D2.5_quick. Total scan time 15.0min include five segments: 1-st segment: delay time 0s, period 20.0s, repeat 1.0; 2-nd segment: delay time 10.0s, period 30.0, repeat 3.0; 3-rd segment: delay time 0s, period 20.0s, repeat 1.0; 4-th segment delay time 440.0s period 20.0, repeat 1.0, 5-th segment delay time 280.0s period 20.0, repeat 1.0. As a MR-contrast agent we used primovist (gadoxetate disodium) 20.0ml, injection speed 2ml/s. Patient underwent CT on 16-slices Aquilion™ LB (Toshiba). We used standard CT protocol for abdomen. Position: head first, respiratory phase: inspiration, scan direction/type: craniocaudal/helical, slice thick/slice Gap 5/1mm, 120kV, 100mA, kernel: FC03. As a CT-contrast agent we used omnipack 350 (Iohexol) 200ml, injection speed 5ml/s.

A chest CT scan revealed solitary foci in the right lower lobe (S6) and left upper lobe (S4) of the liver sized 6 to 7 mm, of which it was difficult to make a proper judgement. The differential diagnosis was made between focal pneumofibrosis and metastatic tumor (Fig. 1).

In the bones at the level of CT section there are multiple dense foci sized from 5 to 26 mm mostly located in the vertebral bodies and spreading to the transverse processes and vertebral arch, as well as in the pelvic bones (Fig. 2). These findings allowed us to suspect the metastatic skeletal lesions.

Analysis of T1 and T2-weighted MR images (WI) from the projections acquired during CT scan showed a low-signal intensity foci and the absence of characteristic for osteoblastic metastases perifocal edema zone at that (Fig. 3). Also, these foci did not show accumulation of contrasting material after dynamic intravenous contrast enhancement (Fig. 4).

In order to elaborate on etiology of focal skeletal lesions we performed bone scintiography with technetium 99m-methylene diphosphate (Tc-99m) which revealed normal osseous uptake of bone imaging agent and no pathological hyperfixation foci in the bones.

CT and MRI examination of abdominal organs revealed a fairly well-defined tumor nodule with dimensions of 63 x 54 x 60 mm, located in segment II (with involvement of segment III) of the left hepatic lobe. The tumor mass was of non-homogeneous structure. Dynamic MR imaging after intravenous bolus injection revealed moderate enhancement during hepatic arterial phase. CT scan showed peripheral hypervascularization and central hypovascularization of the nodule. On post-contrast CT scans the tumor was virtually isointense with the surrounding unchanged parenchyma in the hepatic arteriovenous and parenchymal phases (Fig. 5), and on MRI the tumor had reduced signal intensity. Against this backdrop, the central parts of the tumor showed hypovascular areas resembling necrotic zones. However, the analysis of delayed MR images that were taken at 10 and 15 min. post-contrast enhancement showed that the central parts acquired a hyperintensive signal with concurrent reduction of signal intensity of tumor bulk (Fig. 6).

The CT and MRI findings were highly equivocal. Differential diagnosis had to be done between hepatocellular carcinoma (HCC) and metastatic liver cancer lesions. Taking into account that gadoxetic acid was used as a contrast agent, the enhancement pattern was not typical for HCC. Also, the presence of metastatic lesions in the bones and lungs are not the most common markers for localized HCC.

The patient was admitted to the Abdominal Oncology Department of the Moscow Herzen oncological research institute in order to work out the treatment tactics.

We have performed the ultrasound-guided thick needle biopsy of the hepatic mass. In addition, to verify

Figure 1: CT lung scan. Solitary foci of dense lung tissue in the S6 of the lower right lobe and S4 of the upper left lobe (each encircled by a broken line).

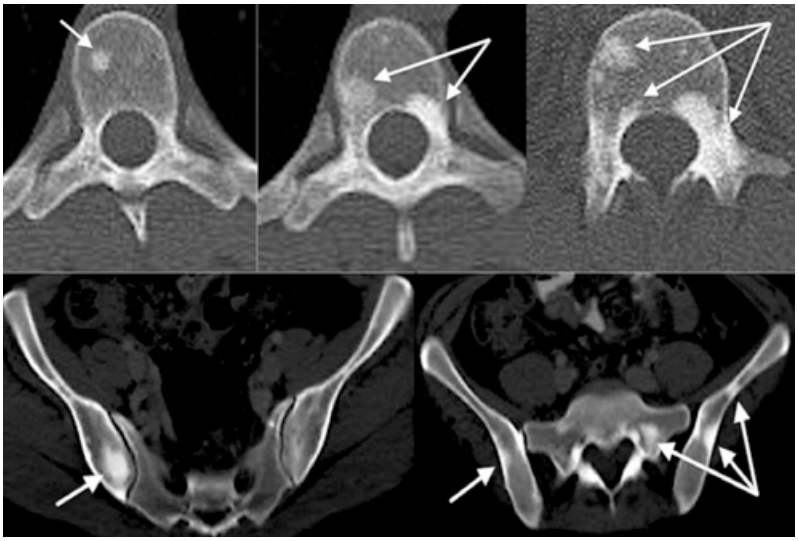

Figure 2: CT scans of the thoracic and lumbar vertebrae and pelvic bones showing multiple foci of dense bone tissue (arrows).

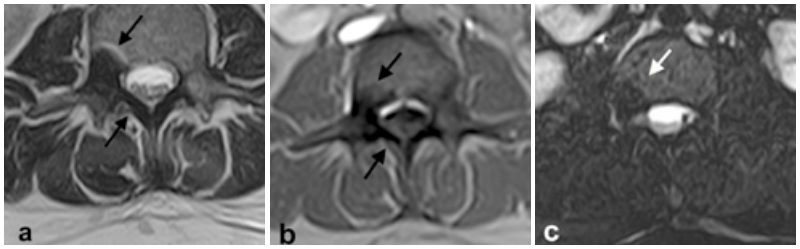

Figure 3: The axial MR images of the lumbar spine at the level of L2: a – T2 WI, b – T1 WI, c – T2 WI with fat saturation (FatSat) images. Focal changes in the vertebral body and vertebral arch are arrowed.

the presence of osseous changes we performed a CT-guided targeted biopsy of one of the foci in the body of the L4 lumbar vertebra (Fig. 7).

The histological and immunohistochemical (IHC) examination of the biopsied mass obtained from the left hepatic lobe revealed the following. Most of the hepatic tissue was replaced by the polymorphocellular lymphoid infiltrate predominantly composed of small lymphocytes with an admixture of plasma cells and eosinophils. Against the backdrop of the infiltrate, there are occasional giant cells resembling Hodgkin cells and Beresovsky-Sternberg-Reed cells.

Leukocytes are positive for LCA, B-lymphocytes - for CD20, T-lymphocytes for CD3, occasional large cells - for CD30, granulocytes and occasional large cells – for CD15, plasma cells - for EMA, B-lymphocytes - for PAX-5 (also, less intense staining in occasional large cells). Approximately 30% of tumor cells express Ki67 antigen. The morphological pattern and immune phenotype are characteristic for classical Hodgkin's lymphoma. Its variant can not be defined because of the insufficient amount of tissue provided.

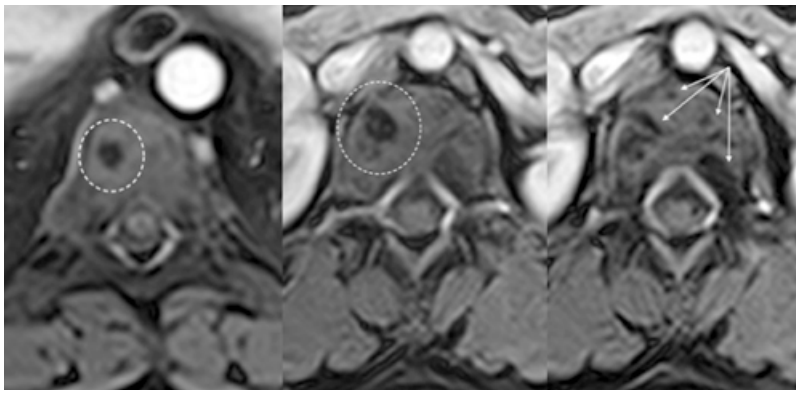

Figure 4: Contrast Enhanced T1 WI MR images of the lower thoracic and lumbar vertebrae present consecutive axial slices. Low-signal intensity foci that do not accumulate contrast material after dynamic intravenous contrast enhancement are encircled by a broken line and arrowed.

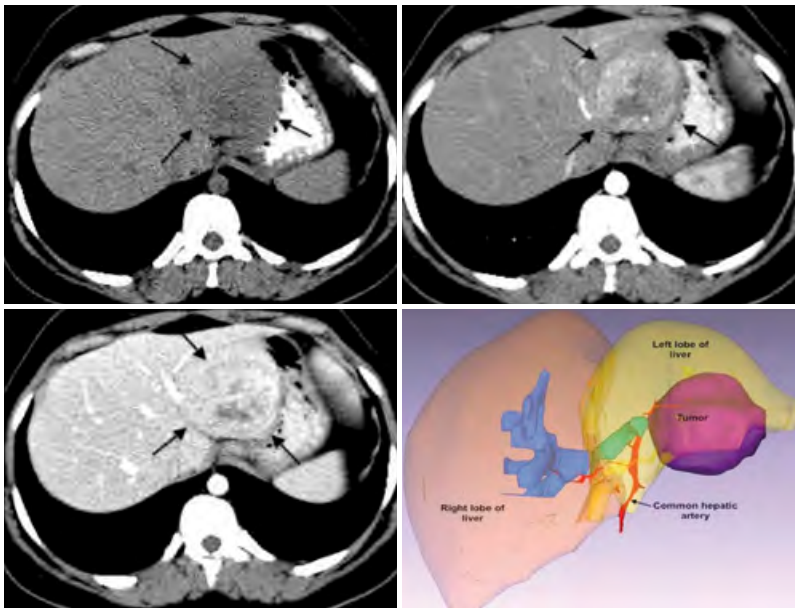

Figure 5: Axial CT scans of abdominal organs (tumor nodule is arrowed): a – native phase, b – post-contrast image, hepatic arterial phase, c – arteriovenous phase, d – 3D model of the liver highlighting the tumor, unchanged parenchyma of the right and left lobes and branches of the hepatic artery and hepatic portal vein.

The additional ICH examination was carried out using cell type-specific antibodies. Large and partly small cells were positive for CD68, small fraction of cells was positive for Bcl 6, plasma cells were positive for CD138 and negative for CD1a, CD30 and glycoforin. These findings indicate an histiocytic sarcoma of the liver (non-langerhans type), ICD-0 code 9755/3.

Results of histological examination of the material obtained from the L4 vertebra biopsy: the biopsy material is represented by a fragment of compact bone tissue with a mosaic pattern, fragmentation and dystrophic changes of the bone plates but with no signs of tumor growth.

Given the results of histological examination of the hepatic mass puncture biopsy and the equivocal results of the chest CT scan regarding the nature of foci in lungs and bones, the patient was subjected to F-18 fluorodeoxyglucose (FDG) positron emission tomography (PET). PET scan revealed a solitary focus of pathological metabolic changes in the left lobe of the liver parenchyma. There was no evidence of the presence of tumor in other organs examined.

After discussing the case at the board of doctors it was decided to conduct surgical treatment, namely, the anatomical liver resection (bisegmentectomy SII-SIII) for liver tumor (Fig. 8).

The dissection of the liver parenchyma was performed using the water-jet dissector and harmonic scalpel. The Pringle maneuver was not applied. The duration of surgical intervention was 115 min., and the intra-operative blood loss was 150 mL.

The post-operative period ran smoothly, and the wound healed by primary intention. The patient was discharged from hospital on day 8 of the post-operative period. According to the post-operative histological examination, the removed tumor nodule is the histiocytic sarcoma of the liver, and the resection edges are intact. Control examination performed 8 weeks post-operation revealed no signs of tumor progression.

DISCUSSION

Histiocytic sarcoma (HS) is a rare tumor, representing less than 1% of all the hematopoietic and lymphoid neoplasms [12, 13]. Malignant histiocytosis or HS occurs mostly in the mononuclear phagocytic system organs, which is manifested in the clinical symptoms of the disease. The most common HS manifestations are lymphadenopathy and skeletal lesions while liver, spleen, lungs, pleura, skin, kidneys, bone marrow and gastrointestinal tract are less frequently affected [14].

This clinical case report may be of interest not only because the HS of the liver is extremely rare but also because there are no universally recognized pathognomic diagnostic criteria. CT scan and gadoxetic acid-enhanced MR imaging of the liver enabled to rule out HCC with a high degree of probability, although failed to solve some other diagnostic tasks.

Based on the overall diagnostic data provided by the CT and MRI examination and histological examination of the liver biopsy, we could suggest that changes in the liver, bones and lungs were of systemic origin which resulted from the same malignant histiocytosis-related tumor process. However, the clinical picture did not fit into the typical manifestations of HS which is characterized by destructive skeletal changes that manifest in the occurrence of osteolytic lesions.

The difficulties with this diagnostic algorithm resided in the presence of two rare pathologic conditions at once, i.e., primary HS of the liver and a metabolic disorder manifested in the occurrence of compact islets of dense bone tissue (a non-typical osteopoikilosis may be considered among other options). The latter merits individual attention and can be presented as an independent clinical case report.
By the same token, the histiocyte-derived malignant tumors are characterized by aggressive course, dismal prognosis and poor response to polychemotherapy.

The prognosis of HS in patients on chemotherapy largely depends on tumor biology (tumor progression rate) rather than on the cytostatic treatment regimen. Unfortunately, the rarity of the disease does not allow the recognition of biological subtypes which are characterized by a more favorable course. However, several developments in recent years towards using more intense therapeutic regimens, as well as the encouraging results of implementation of targeted antitumor drugs, allow us to hope for possible improvement of prognosis in patients with HS [15].

There are medical literature reports on the use of imatinib, sorafenib and bevacizumab which were administered depending on detected expression of the platelet growth factor, vascular endothelial growth factor or epidermal growth factor receptors [16]. The effectiveness of thalidomide (in combination with CHOP chemotherapy regimen) has been shown when used as an induction therapy in patients with histiocytic sarcoma or as a maintenance treatment after high-dose chemotherapy followed by autologous blood stem cells transplantation [17]. There are reports on successful use of alemtusumab (CD52 antibodies) in patients with advanced chemotherapy-resistant HS expressing CD52 antigen [18]. However, considering the rarity of the disease and, hence, low likelihood of conducting a large-scale prospective trial, the therapy for HS is likely to remain empirical for a rather long time.

The absence of uniform treatment standards for HS, equivocal efficacy of different chemotherapy regimens and low effectiveness of radiation therapy make surgical

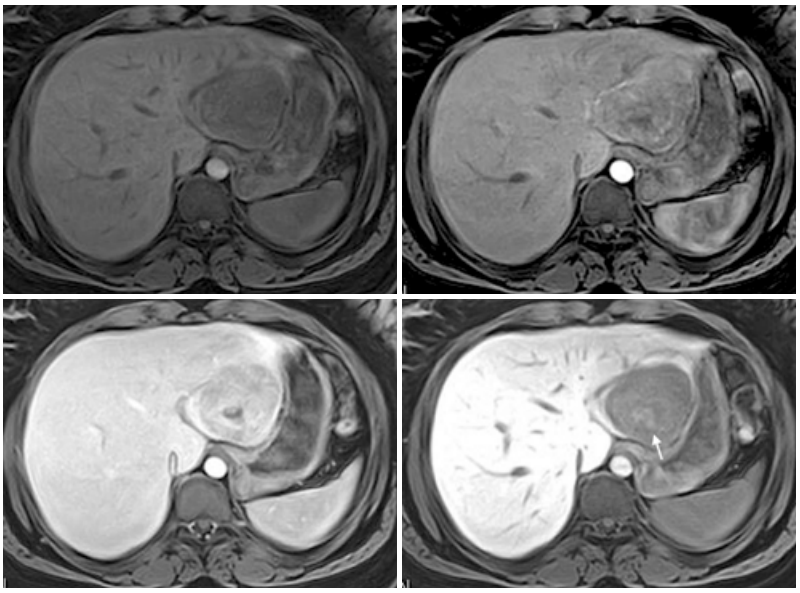

Figure 6: MR images of abdominal organs (T1 WI axial images): a – before contrast enhancement, b – post-contrast enhancement, hepatic arterial phase, c – parenchymal phase, d – delayed phase (central part of the tumour shows hyperintense signal - arrowed).

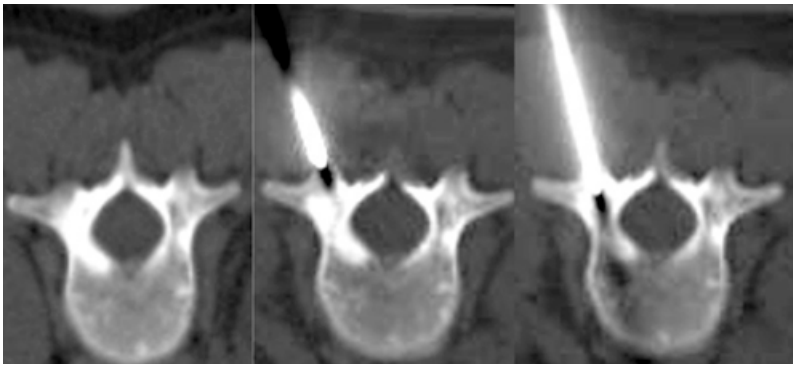

Figure 7: CT scan of the L4 lumbar vertebra demonstrating the CT-guided puncture biopsy steps.

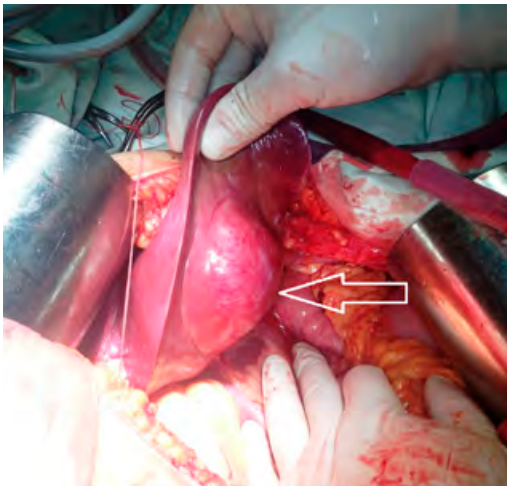

Figure 8: Operation view (tumour arrowed)

management of localized tumors an obvious choice [18]. This conclusion is supported by reports of effective surgical treatment in HS patients with isolated lesions of spleen and terminal ileum [13-19].

Our case report demonstrates difficulties with differential diagnosis of primary tumors of the liver and confirms the requirement for accurate morphological verification of tumor process before the start of the antitumor therapy.

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320-row CT as a single and effective platform for anatomical and functional evaluation of coronary artery disease: the CORE320 trial

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A single 320-detector row CT examination that combines coronary angiography and myocardial perfusion is effective in the detection of haemodynamically significant coronary stenoses, according to the international, multicenter trial CORE320. The results have recently been published in the European Heart Journal[1].

CLINICAL NEED FOR BOTH ANATOMICAL AND FUNCTIONAL ASSESSMENT

In the diagnosis and management of coronary artery disease (CAD), imaging plays an increasingly important role. In particular, non-invasive CT coronary angiography (CTA) has emerged as an attractive tool for initial evaluation of patients presenting with symptoms or other signs suggestive of CAD. Yet an important limitation of this particular approach is that it only provides information on the anatomical severity of disease. In contrast, knowledge whether detected coronary stenoses result in reduced myocardial perfusion is crucial for further management, such as assessing the need for coronary intervention. This notion has fuelled the development of CT myocardial perfusion (CTP).

While initial studies have shown the feasibility of combined CTA and CTP, these experiences were limited to single-center evaluations in small patient cohorts. However, for a test to be accepted in the clinical arena, more robust, prospective data are needed. Recently, the results from the first large, international, multicenter trial on this topic, the CORE320 trial, have become available, confirming the value of combined CTA and CTP with 320-detector row CT.

STUDY DESIGN AND METHODS

Researchers from 16 sites in eight countries enrolled 381 patients who were referred for cardiac evaluation because of suspected or known CAD (Fig. 1). All patients underwent a comprehensive imaging protocol consisting of combined CTA and adenosine stress CTP as well as myocardial perfusion imaging (MPI) by means of SPECT prior to conventional invasive coronary angiography (ICA). Imaging data were evaluated by four independent blinded core laboratories.

Figure 1: Participating countries.

For the reference standard, each patient and vessel was classified as normal or having CAD, defined as ≥ 50% coronary stenosis by ICA with an associated perfusion defect by SPECT MPI in the corresponding territory. An example dataset of the four imaging components is provided in Fig. 2.

CLEAR BENEFIT WHEN ADDING CTP TO CTA

Based on the gold standard, 38% of patients were positive for CAD. The patient-based diagnostic accuracy defined by the area under the receiver operating characteristic curve (AUC) of integrated CTA–CTP for detecting or excluding flow-limiting CAD was 0.87 [95% confidence interval (CI): 0.84–0.91]. In a next step, the analysis was repeated in patients without prior CAD, revealing an even higher AUC of 0.93 (95% CI: 0.89–0.97). For the combination of a CTA stenosis ≥50% and a CTP perfusion defect (summed stress score ≥4), the sensitivity, specificity, positive predictive, and negative predicative values (95% CI) were 80% (72–86), 74% (68–80), 65% (58–72), and 86% (80–90), respectively.

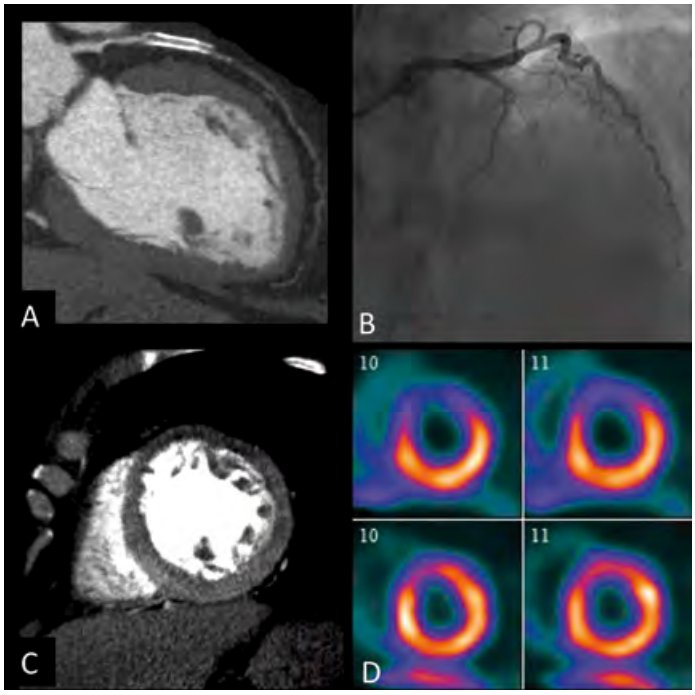

Figure 2: An example case of the four study imaging components.
Panel A depicts a CTA image with an occlusion of the left anterior descending artery.
Panel B depicts an ICA image confirming the occluded left anterior descending artery.
Panel C is a stress CTP short-axis reconstruction with a defect visible in the anterior wall. In this patient, defects were seen on CTP in the basal anterior (severe), distal anterior (severe), distal anteroseptal (moderate), and apical (moderate) walls. Distal anterior and apical defects had fixed components.
Panel D: SPECT MPI images with perfusion defects in the distal anterior (severe), distal anteroseptal (severe, fixed), and apical (severe) walls.

Importantly, when comparing the AUC of the combination of CTA and CTP to the AUC of CTA alone, the authors observed a significant increase in diagnostic accuracy for the addition of CTP. This improvement in the detection of flow-limiting disease was seen both at the patient and vessel level. These data confirm that the addition of CTP to CTA provides a clear benefit in the evaluation of CAD.

RADIATION DOSE

Although no iterative reconstruction algorithms were available at the time of data collection, the median estimated total body effective radiation dose for the combined CTA–CTP protocol (9.32 mSv) was still lower than those for SPECT and ICA (9.75 and 12.0 mSv, respectively). Even more, with the recent introduction of iterative reconstruction algorithms, considerably lower radiation doses can be achieved.

ADVANTAGES OF 320-DETECTOR ROW CT FOR CTP

For this study, a dedicated 320-detector row CT scanner (Aquilion ONE™) was used. While CTP may be performed on less advanced scanners, there are several important advantages of using a dynamic volume CT system. Since the entire heart is acquired in a single heart beat, a single temporally uniform volume is obtained. The resulting uniform contrast enhancement facilitates myocardial perfusion analysis substantially. Accordingly, higher success rates as well as improved diagnostic accuracy can be expected.

CONCLUSION

In conclusion, the non-invasive combination of CTA and CTP with 320-detector row CT performs equally well as the conventional gold standard (ICA in combination with SPECT MPI) to detect flow-limiting CAD. As the study investigators write, CORE320 establishes CT as a single imaging platform to gather both morphologic and functional information with high accuracy. The trial provides an important foundation for further studies that may help in defining the clinical applicability of combined CTA and CTP in more detail.

Toshiba provides guides to perform and interpret CT myocardial perfusion examinations. The Aquilion ONE Myocardial Perfusion Scan Guide and Myocardial Perfusion Interpretation Guide are available.

Rigshospitalet (University of Copenhagen, Denmark), one of the CORE320 sites, conducts a CT Myocardial Perfusion 2 day Introduction Course and a 3 day Advanced Course at various times throughout the year. These courses include both scanning techniques and interpretation of CT myocardial perfusion. Details can be found at www.rh-ct-cardiacperfusion.dk.

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Toshiba Medical Systems Secondlife Mobile CT

Medical trailers come in all shapes and sizes. Some are so well-designed and highly-equipped that they can be considered as 'works of art' that can deliver high-quality medical services for years. VISIONS was offered the opportunity to explore one of these state-of-the-art pieces of technology during its construction - Toshiba Medical Systems' Secondlife mobile CT scanner, which was designed to meet a wide variety of needs in temporary medical imaging.

Toshiba Medical Systems' Secondlife Refurbished Equipment Division recently developed their second mobile CT unit. The mobile CT trailer was designed to meet a variety of requirements, such as 'emergency down' situations, planned replacement, or expansion and much more. Equipped with Toshiba's Aquilion™ CXL CT scanner and Viamo™ ultrasound system, the unit represents a quantum advance in imaging, with precise isotropic resolution that delivers unprecedented power, flexibility, and diagnostic possibilities.

The first mobile CT unit made by Toshiba Medical Systems Secondlife has been in use since 2011. Following the success of this unit, a second was created in 2013. Using the experience gathered, Toshiba Medical Systems Secondlife were able to implement various changes and improvements in the second unit produced. Partner company, Lamboo Mobile Medical, a global organization specialized in the engineering, manufacturing and refurbishment of mobile and modular healthcare solutions, collaborated with Toshiba Medical Systems Secondlife to realize the finishing touches to the new mobile CT unit. While it might appear relatively straightforward to create a mobile CT scanning device, VISIONS discovered first-hand how challenging some of the aspects of the task from the design and engineering team of Toshiba Medical Systems Secondlife.

DESIGN CHALLENGES

Firstly, the chassis must be chosen. Toshiba Medical Systems Secondlife selected a used chassis, which had been previously used as a mobile imaging resource. A conscious choice made on the basis of the relatively small number of kilometers driven annually in previous use. The chassis used for development of the trailer, for example, had been driven less than 10,000 km.

Once the chassis was chosen, the second stage could begin. The trailer arrived at Lamboo Mobile Medical in Zoetermeer, The Netherlands and was customized in the workshops there to meet all requirements. During VISIONS visit, it became increasingly clear how much consideration and planning was completed before the engineers in the workshop could start work. A 'box on wheels' measuring 12m long, two-and-a-half meters wide and four meters high, appeared to be a large volume and simple construction to work with, but in the practice of transformation, many challenges were encountered. Toshiba Medical Systems Secondlife explained that the majority of challenges are presented by the fact that the trailer must meet many different (legal) requirements to be deployed throughout Europe. Accepted and approved solutions in one country, sometimes present issues in others. In the Netherlands, for example, the trailer could have been a bit wider, while still remaining within the legal standards. Sliding walls mean that the sides can be partially extended outwardly on both sides, thus increasing the floor area considerably, when the trailer is at a hospital or clinic. The inside walls surrounding the actual CT scanner were constructed from two and three millimeter-thick sheets of lead, which ensures safety from radiation and that the measured radiation dose outside the unit is always within the legal standards.

Control Room

Toshiba's Secondlife Mobile Imaging Truck

MEETING SPECIALISTS' NEEDS

Regarding the floor of the unit, demands and regulations mostly concerned the working surface. For example, sufficient distance between the scanner and the walls of the trailer were required to provide staff with adequate space to do their work. The interior is designed to suit the specialist healthcare professionals. The control room offers radiographers a spacious and light working environment with built-in stereo CD/MP3 player. The working area is also equipped with lots of storage space. The accessibility of a phone line, data ports, digital interfacing, and DICOM 3.0 connectivity in the mobile CT Units facilitates maximum versatility in communication with the rest of the hospital. The mobile unit has also a Vitrea digital 3D workstation, up to 2TB external image storage capacity and InnerVision remote service support connectivity on board.

The mobile CT unit within the trailer uses a standard power connector to comply with the power outlets already supplied the hospital. Fresh water and black water connections can be made from the trailer to the facility. The mobile CT unit can be used as completely self-supporting imaging solution. It has its own aggregate, climate control and a lift for patients, who may be admitted on a trolley. The hydraulic patient lift on the trailer ensures safety and convenience for staff and patients alike.

OPTIMAL PATIENT COMFORT

The well-being of the patient is, of course, paramount. Calmness, spaciousness and soothing colors provide the most comfortable environment possible, so even decorative details of the trailer's interior and exterior count. While the outside of the Mobile CT is built to suit the environment, in which, it is placed, the interior is built to suit the patients, radiologists and radiographers. The environmentally-sensitive design of the mobile CT unit includes the attractive internal and external color scheme, wood-design interior, ambient lighting and advanced climate control system.

Mobile CT system and soothing scenes on the ceiling and side wall.

Patients examined in a CT scanner, can sometimes experience a claustrophobic feeling. In addition, lying still and silent for some time can add to the discomfort of the experience for many people, especially for young patients. Soothing scenes on the ceiling and side wall of the mobile CT unit are designed to provide a pleasant distraction for patients.

For the privacy of patients, a cubicle is provided, accessible via easy-to-use stairs at the side of the trailer. A technical cabinet for the computer equipment and generator is also integrated. In short, no space is left unused! And yet the total weight of the trailer does not exceed twelve tonnes.

ACCESSIBLE CARE

The biggest challenge is not necessarily building such a high-quality trailer, but designing it to offer optimal accessibility in the places where the trailer is generally used. Hospitals and nursing homes are generally not easily accessible for trucks. There is often only limited space.

However, there is always the need to park the mobile CT unit as close as possible to the hospital building, so that patients can access the unit easily, quickly, and comfortably. This was the reason for selecting a tractor-trailer combination, and not, for example, an integrated bus chassis. Because mobile scanners are usually located for long periods near a hospital or institution, there is no need for a more mobile bus unit. Partnership with the assigned carrier of Toshiba Medical Systems Secondlife means that the carrier provides towing of the vehicle at any location. Thus, the tractor can be used for towing in other areas, instead of remaining unused for days. During VISIONS visit, the finishing touches were being made to match the agreed delivery date. As you read this, the new acquisition will be in service for Toshiba Medical Systems United Kingdom. After that, the trailer will be employed across Europe.

Secondlife

About Toshiba Medical Systems Secondlife

Toshiba Medical Systems Secondlife specializes in selling and acquisition of pre-owned and ex-demonstration medical imaging equipment: CT, MRI, Ultrasound, X-ray, C-Arms, and more. Toshiba Medical Systems Secondlife provides short- to long term medical diagnostic imaging solutions, such as trade-in on all Toshiba Medical Systems and non-Toshiba products (Ultrasound, CT, MRI and X-ray). All Toshiba equipment will be refurbished to equate 'factory quality' backed by a one-year warranty – just as any new system.

Toshiba Medical Systems Secondlife also provides professional dismantling services. In addition to their specializations, they deal with most other types of healthcare equipment including mobile units and occasionally complete hospital installations. The technical department works in their own facilities, as well as onsite, in clinics and hospitals throughout the European territory to supply the highest quality equipment.

MUSEUM
BEELDEN
AAN ZEE

Hidden in the dunes of Scheveningen, like a pearl in the sand, you will find museum Beelden aan Zee, a truly unique museum in the Netherlands that focuses on modern and contemporary international sculpture. Man - the human image - is the leitmotiv of the collection of Beelden aan Zee. The collection holds work from sculptors as: Karel Appel, Atelier van Lieshout, Fernando Botero, Cesar, Tony Cragg, Igor Mitoraj, Jan Meefout and Ossip Zadkine.

As from January 31st 2014 the following exposition can be seen at museum Beelden aan Zee:

- Caspar Berger - *Bone*.
- Yubi Kirindongo - *Rebel in Art & Soul*.
- George Minne - *Voorbode van de Moderne Kunst* & Nick Ervinck - *GNI-RI*.

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MUSEUM
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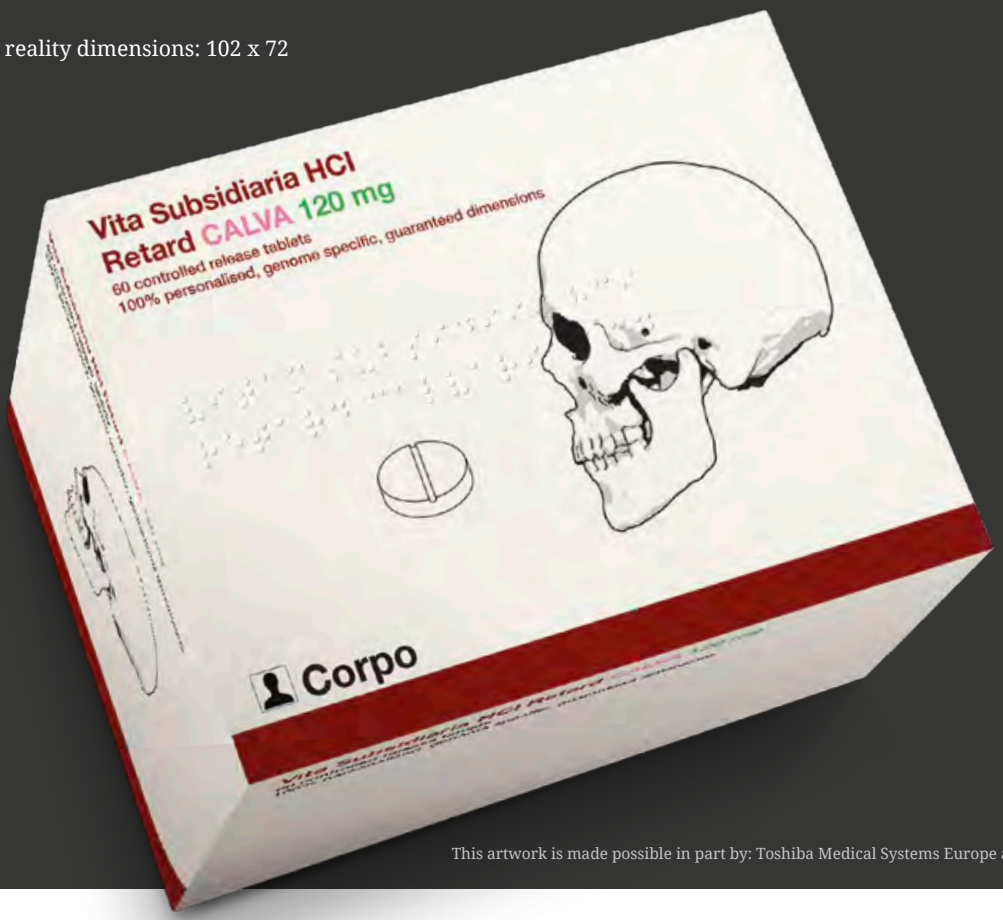
Caspar Berger - Bone at Beelden aan Zee

Vita Subsidiaria Calva/Self-portrait 31 (excerpt)

Caspar Berger, 2014
Material: Print, argmented reality dimensions: 102 x 72



This artwork is made possible in part by: Toshiba Medical Systems Europe and Beyond Reality

This artwork is about the question of whether we can rethink life, faced with the possibility of science cracking the code of life, of being able to make and fix life. If we were offered the choice, would we dare to be immortal?

*Download the '**Caspar Berger Skeleton**' app, point your mobile device at the artwork and give the skull a check-up!*

Available on the App Store | ANDROID APP ON Google play

About the Bone Exhibition

For his project 'Skeleton', award-winning Dutch artist, Caspar Berger, made an exact copy of his own skeleton using a Toshiba Aquilion CT scanner and 3D-print technology, which he then incorporated into a wide variety of creative interpretations. The result is a lifelike 'interior' portrait of the artist, although none of the individual works features his fully intact skeleton. For 'Bone', Berger explored, for example, the concept of humans in fossil form. The hard parts of his body were effectively 'preserved' in stone objects. The piece entitled "Do Not be Afraid of Becoming a Bench/Self-Portrait 28" contains casts of all the bones of his skeleton. While seated on the stone benches, which can be interpreted as symbolizing the possible role of Man in the history of the World , the viewer can watch the video projection, entitled 'Attraction/Self-Portrait 30' which shows a reversed process of creation. In the video, silver-grey balloons with cast parts of Berger's skeleton attached descend from a cloudy sky. Then the sun emerges, encouraging viewers to question if Man's 'place' is actually between heaven and Earth.

About Caspar Berger

Sculptor Caspar Berger (1965) studied at the AKI, Enschede and at the Jan van Eyck Academy in Maastricht, the Netherlands. In his work Berger investigates the relationship between the interior and exterior, between reality and image. Berger gives shape to his ideas using silicone casts of models and of his own skin or even what's underneath, leading to its end result in bronze, silver and sometimes gold; more recently, video installations, concrete and print. In 2013 he was awarded Singer prijs 2013 and recently he received the Sacha Tanja Penning 2014.

www.casparberger.nl