

TOSHIBA MEDICAL SYSTEMS MAGAZINE 2013

VISIONS

COMPUTED TOMOGRAPHY

From bone subtraction to organ perfusion

ULTRASOUND

Fly Thru and Smart Fusion: Advanced techniques for better diagnostic accuracy

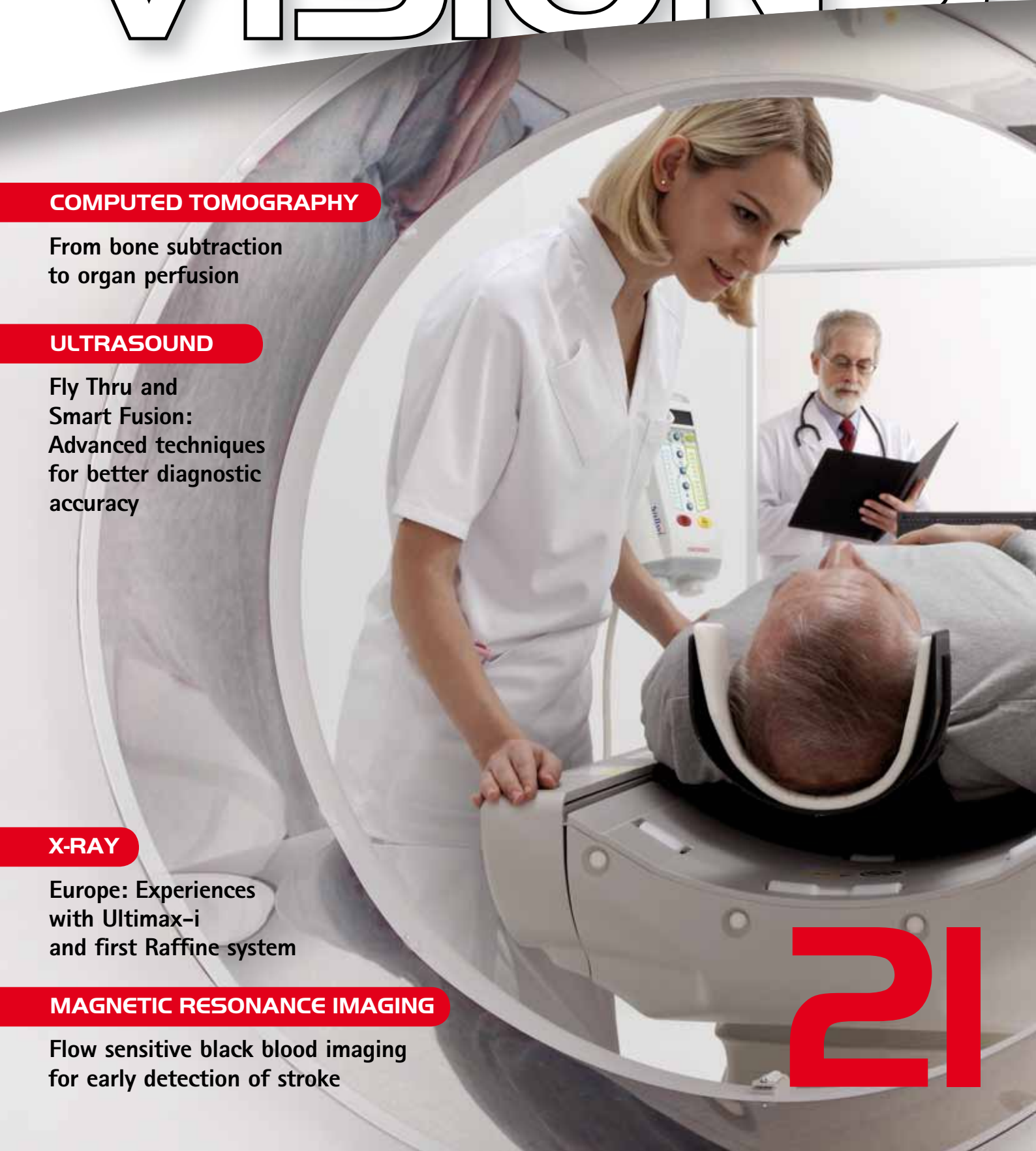
X-RAY

Europe: Experiences with Ultimax-i and first Raffine system

MAGNETIC RESONANCE IMAGING

Flow sensitive black blood imaging for early detection of stroke

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Imprint

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Dear reader,



Sharing my passion for and deep interest in Japan and having actively studied martial arts together for many years one of my closest friends accompanied me on a visit to an international exhibition dedicated to the samurai¹; the military nobility of pre-industrial Japan.

The exhibition brings together unique items from private collections and museums in Japan and throughout Europe. It reflects an interesting time when warlords, the *Daimyō*, fought each other by employing the services of fearsome samurai warriors and illustrates the highly developed warrior culture of that period.

Walking through the museum, we were very impressed by the beautiful armor, spectacular helmets and magnificent swords that were deemed to reflect the 'soul of the samurai'. Also on display were war banners, *Nobori*, from the *Kitamura Collection*, painted with family coats-of-arms and protective mythological figures, to identify the samurai on the battlefield.

One particular *Nobori* showed a Koi Carp bravely climbing a waterfall. Legend states that once caught, the fish will lay on the cutting board awaiting the knife without a quiver. In Koi symbolism, this has been likened to a samurai warrior facing a sword. Ancient legend also said that a Koi that succeeds in climbing the falls is transformed into a dragon. Based on that legend, the Koi, at that time, was symbolic of worldly aspiration and advancement.

The code of ethics, *Bushido*, imposed a lifestyle of honor, loyalty and respect within the warrior class. The samurai-elite devoted themselves with equal dedication to various arts such as calligraphy and the tea ceremony, and they wore delicately crafted accessories, including *Netsuke* and *Inrō* lacquer work. A surprising element is the Dutch influence on the samurai warrior equipment, caused by the special bond between the two countries.

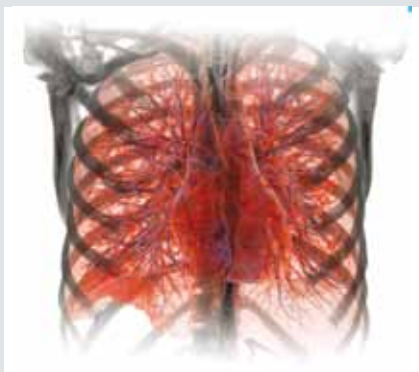
Working close to a decade at Toshiba, I can proudly say that the same ethics, devotion and dedication is being applied daily to our product development and production, marketing and sales, service and support and above all, to the way we work together with our customers to provide integrated diagnostic solutions through long-term partnerships.

We are committed to achieving the best in patient safety across all modality products and it is our dedication and continuous mission to improve the overall quality of life of all people.

Kind regards,

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

With Toshiba's newest and most advanced CT system, the Aquilion™ ONE /ViSION Edition, diagnosis goes faster and safer – Pages 6 and 12



Two experts in medical technology join forces – Page 22

This edition of VISIONS magazine is covering Toshiba's European region and as such reflects products, technologies and services for that area. All mentioned products may not be available in other geographical regions. Please consult your Toshiba representative sales office in case of any questions.

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Two iconic brands come together:
Toshiba supports Manchester United
Football Club as its Official Medical
Systems Partner – Page 32



Raffine and Ultimax-i improve diagnostics
and workflow in Russia and Scotland.
Page 54 and 58

Clearly Better – Toshiba's ViSION Edition Launched in Europe

Professor Mathias Prokop is one of the world's leading experts on body imaging. With a particular interest in new CT technologies, he has explored the boundaries of this modality for the last 25 years, heading many research institutes and projects worldwide. As Chairman of the radiology department at Radboud University Medical Center in Nijmegen, one of the Netherlands' most well-known academic hospitals, he recently acquired Toshiba's new ViSION Edition™ system for his multi-disciplinary team. This state of the art system, which provides new clinical options through its faster rotation time, improved dose efficiency, wider bore and enhanced range of applications, is the first to be installed in Europe. VISIONS Magazine talked to Professor Mathias Prokop to find out more about his decision to invest in the new system and experiences with it since installation in July 2012.

Professor Mathias Prokop and his team are happy to use the world's most advanced dynamic volume CT system.

VISIONS: Radboud University Medical Center is the first hospital in Europe to receive a new Toshiba Aquilion ONE ViSION. What was behind the decision to choose the system?

Prokop: I chose this system because of its superior image quality, fast rotation time, modified detector system and ultra low-dose capabilities. I thought Toshiba's Aquilion ONE was a good machine that brought real advantages in both clinical practice and research, and as a next generation system, the ViSION Edition offers even more benefits. As with

“ Being able to view images instantaneously has a huge impact on our work. ”





Main entrance of the St. Radboud hospital

its predecessor, we can scan all organs within one rotation. However, the gantry rotation is accelerated from 0.35 seconds with the Aquilion ONE to 0.275 seconds with the ViSION Edition. This faster time opens up new possibilities for reducing the impact of image artifacts and improving image accuracy in cardiac imaging, for example, or pediatric or emergency investigations, in which it can be difficult to minimize movement of the patient, as well as enabling us to perform a broader range of perfusion examinations and increasing our workflow. The ViSION Edition has integrated Adaptive Iterative Dose Reduction (AIDR) 3D that enables us to achieve even lower dose scanning. Its wide, 78 cm bore set-up allows fast and easy set up for any type of clinical examination.

In addition, I was able to work together with the Toshiba development team on certain issues when the system was in the final stages of development. I very much like to contribute to new things. I see this as a way of providing input into the future of CT.

VISIONS: You worked quite extensively with the Toshiba team in Japan during development of the ViSION Edition. What sort of issues were you involved in?

Prokop: My collaboration involved developing a digital phantom to establish new standards for the machine and exploring the effect of varying many factors, such as the influence of different algorithms, the timing of the scan, filtering and sequence of dose variables. Through these investigations, we discovered some optimum calibrations for separate components. One particular interest that I have is exploring brain perfusion with the machine, since it is ideal for both research purposes and clinical practice, and I have been working with Toshiba on this too.

VISIONS: Now that it is installed, what do you particularly like about the system?

Prokop: The ViSION Edition is altogether a very impressive scanner. There are many incremental improvements compared to the Aquilion ONE. The image quality achieved with the system is superior

“ I chose this system because of its superior image quality, fast rotation time, modified detector system and ultra low-dose capabilities. ”



and immediately accessible, affording us greater capabilities in trauma and emergency care, cardiology and neurology, and the chance to carry out a wider range of perfusion techniques. With real-time construction of images we have far more scope to scan trauma and emergency patients and assess condition quickly. The image subtraction feature on the ViSION Edition is improved, offering us enhanced options in this method, which minimizes artifacts. The software capabilities with the new machine are amazing. The perfusion software is so flexible that we can jump to imaging other organs without interrupting the examination on one. The new system has good warping capabilities for scanning all organs. We have already achieved good results with imaging spleen and kidneys. Bowel imaging is currently not quite so straightforward, but we are exploring the possibilities with the ViSION Edition. The new software for brain imaging is a unique, new feature. This is a particular interest of mine. Advances in CT imaging of the brain could be beneficial in working with stroke patients, for example. We haven't yet explored the 3D fluoroscopy capabilities of the machine but with the ViSION Edition this is available. Dose reduction is so effective that we are able to make CT scans using a dose range equivalent to that used for X-ray – a substantial reduction of up to 75%.

VISIONS: How was training to use the ViSION Edition?

Prokop: It was a very smooth transition into starting to use the new system as there is very little difference in operation from the Aquilion ONE. There are no new operational issues and some things have even been made even easier and faster to use.



research. Being able to view images instantaneously has a huge impact on our work. The system has already improved our workflow and we are able to use it for an increasing number of applications. We are able to use lower than ever doses and achieve higher patient- and consultant satisfaction. It also reduces our costs.

VISIONS: How about the service you have received from Toshiba?

Prokop: We are very happy with the excellent service we received from Toshiba's team in Japan and

“ Toshiba's Aquilion ONE was a good machine that brought real advantages in both clinical practice and research. As a next generation system, the Vision Edition offers even more incremental benefits. ”

VISIONS: What comments have your colleagues made about the new system?

Prokop: The trauma unit in particular has benefited already from the speed of the ViSION Edition and the extended range of high quality images that can be achieved. Even the upper extremities, for example, can easily be scanned in very short spaces of time. The emergency staff at the hospital continue to be amazed by the immediate diagnosis possibilities provided by the new machine. It is an ideal system for use in trauma and emergency care. Our neurologists are using the scanner for both regular neurological assessments and also advanced CT perfusion techniques. They are exited about the image quality produced by the system. Our cardiologists can perform a broader range of examinations and are now using CT perfusion techniques, which they were not able to perform before. It has actually changed the way our cardiologists think about the use of CT in their field. I believe that CT will become the imaging modality of choice for an even wider range of diagnostics, and with the Toshiba ViSION Edition I am able to convince my colleagues of this too.

VISIONS: What difference has the system made to the radiology department in general?

Prokop: The department serves a total of 18 resident radiology specialists, is staffed by 30 employees and is used to diagnose approximately 100,000 patients per year. The ViSION Edition is a very welcome addition to our two existing machines in the department. It is in constant use for a very broad range of applications from trauma and emergency care and a wide range of clinical applications to

Toshiba Medical Systems Europe in the Netherlands. As one of the first users of different generations of CT scanners, I am familiar with the risks involved in purchasing and installing new systems. I know what can happen and what the pitfalls are but in this instance, there were only very minor issues to work on. Overall, the collaboration during development, the added benefits of the new ViSION Edition and the service package provided by Toshiba have been outstanding.

VISIONS: Thank you.



In addition to having produced hundreds of scientific papers on leading issues in body imaging, Professor Prokop is co-author of one of healthcare's best known reference titles on CT techniques, **Spiral and Multislice Computed**

Tomography of the Body, (ISBN 978-3-13-116481-0 (TPS, Rest of World), ISBN 978-0-86577-870-2 (TPN, The Americas), Mathias Prokop and Michael Galanski. The title is a worldwide bestseller and whilst the book was so advanced for its time that it still has perfect relevance today, a new edition is currently in the pipeline.

Musculoskeletal Disorders: DSA-like Bone Subtraction with 320-Detector row CT

P. Teixeira

Introduction

CT is a frequently used imaging method for the evaluation of bone lesions and densely calcified soft tissue musculoskeletal lesions. It elegantly demonstrates the lesion's contours and the reactive changes of the bone and periosteum adjacent to it, features which are fundamental for lesion characterization. Some lesions however require further analysis to reach a conclusive diagnosis or narrow down the possible differential diagnosis. The intravenous injection of contrast media is one of the most frequently used tools to help in the characterization of musculoskeletal lesions.

On CT, enhancement after iodinated contrast injection is readily seen in lytic and non-calcified soft tissue lesions. The visualization of contrast enhancement in non-lytic bone lesions is however practically impossible with conventional CT techniques because the high density of trabecular and cortical bone obscures the visualization of the hyperdense iodinated contrast. This represents one of the main advantages of MRI over CT for the evaluation of non-lytic or densely calcified lesions because

in MR calcium does not directly interfere with the visualization of the contrast media.

The typical example of a non-lytic, enhancing bone anomaly with major diagnostic implications is the so called bone marrow edema pattern (BMEP). BMEP can be present in association with multiple tumors, inflammatory, degenerative and traumatic conditions and is composed of a mosaic of different histologic anomalies (fibrosis, trabecular thickening, cellular infiltration and to a lesser extent edema)¹. BMEP invariably enhances and its identification is important for lesion characterization and may have significant prognostic implications which can directly influence patient management². Normally BMEP is only seen on MR since the normal bone precludes the visualization of this anomaly on CT.

DSA-like (Digital subtraction angiography) bone subtraction is a CT technique that allows removal of calcifications and bone (both cortical and trabecular) without affecting the visualization of adjacent contrast enhanced structures. This technique allows the identification of contrast enhancement on CT of a non-lytic bone lesion and can be useful in vari-

Case 1

Why is it different?

MRI T2FS

Classic bone removal

X-Ray

DSA bone subtraction

Focal lytic bone lesion with marked cortical thickening in an elderly patient

Cortical enhancement has a similar density than the cortical bone and is taken away with classic bone subtraction

With DSA bone subtraction the full extent of cortical enhancement is demonstrated. This patient has a biopsy proven focal Paget's disease

Paget's disease

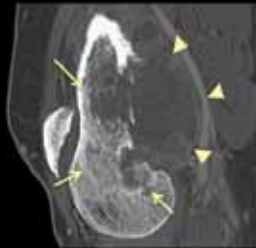
University Hospital (CHU) Nancy
Radiology Department,
Nancy, France

Case 2

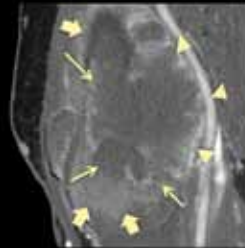
MRI
(T2 fat saturated sag)



CT perfusion



CT perfusion
CT with DSA-like bone
subtraction



This lesion has three components: Soft tissue (arrowheads), lytic bone (thin arrows) and nonlytic bone (fat arrows). As expected MR imaging can depict all three components. In conventional CT perfusion, however the nonlytic component is not seen. With DSA-like bone subtraction enhancement is seen in the nonlytic areas of the bone, matching the enhancement seen on MR. This information has obvious importance in the surgical planning.

Local staging of a lytic bone lesion, 64 year old female, Femur sarcoma

ous clinical settings such as tumor characterization, tumor staging, occult fractures and inflammatory diseases. Additionally DSA-like bone subtraction can be performed with conventional CT protocols (pre- and post-contrast) as well as with dynamic CT perfusion.

DSA-like bone subtraction offers a great advantage over conventional density-based bone subtraction techniques on CT. In the latter methods the bone and calcification are segmented from the adjacent vessels and soft tissue based on their density and morphology. When there is intra-osseous enhancement there is no difference in morphology or in density making it impossible to separate the bone from contrast enhancement. As a result, intra-osseous contrast enhancement is removed along with the bone with the consequent loss of important diagnostic information. In this manuscript a description of the principles of this technique is provided along with examples of its clinical applications (Case 1 & 2).

Basic principles

As its name implies DSA-like bone subtraction uses the same principle of bone subtraction as used for interventional radiologic procedures. A mask for subtraction of the anatomic region to be studied is acquired before contrast injection. Contrast is then injected and the post-contrast image acquisition is performed normally. During post-processing the two image sets are registered so that every anatomic structure corresponds exactly. Finally the registered image sets are subtracted. Since for X-ray based imaging methods calcium and metal are usually the only spontaneously dense structures to be found before contrast injection the result of the subtraction is an image set in which bone and

other hyperdense structures have been completely removed and only the enhancing structures remain (Case 1 and 2).

Image registration is at the heart of DSA-like bone subtraction. If the pre- and post-contrast volumes are not meticulously matched pixel by pixel, artifacts are introduced into the subtracted images. Most of these artifacts are related to patient motion between the two acquisitions. Together with the greatly reduced acquisition time provided by current 320-detector row CT scanners (less than 0.5 s for the whole volume) the use of non-rigid registration algorithms can help overcome motion related artifacts. With

the development of robust registration algorithms dedicated to the bone analysis, intra-osseous enhancement can be confidently identified. Until now, this type of bone removal was not available in clinical practice because the subtraction of conventional helical acquisitions is technically demanding and time consuming. 320-detector row CT scanners can image up to 16 cm in a single rotation of the X-ray tube using a sequential acquisition mode. Using this type of acquisition the subtraction of pre- and post-contrast volumes is simpler and faster. Similar to DSA, a pre-contrast volume (mask) is subtracted from a post-contrast one and after post-processing a new volume, in which only contrast enhancement remains, is generated.

Material and methods

Dedicated bone subtraction algorithms were used for the evaluation of patients referred for CT imaging at our institution for the diagnostic work-up of suspected bone lesions. All CT images were acquired with a 320-detector row CT scanner (Aquilion ONE, Toshiba Medical Systems, Otawara, Japan) using a sequential scan mode before and after injection of iodinated contrast media. An iterative reconstruction algorithm (AIDR 3D) was used and the tube output parameters (kV, mAs) were adapted to the patient body habitus in order to keep the exposure dose to a minimum.

The images were then post-processed using SURESubtraction Ortho software. The subtracted images were compared to conventional CT images and correlated to MRI when available. Selected cases that demonstrate the added diagnostic value of DSA-like bone subtraction are presented.

Clinical experience

There are many potential clinical applications of DSA-like bone subtraction. From our experience this technique is particularly useful in the following clinical contexts:

Identification of BMEP

CT studies are often performed for the evaluation of osteomyelitis or spondylodiscitis, however structural bone anomalies and bone changes may not be present in the acute phase, precluding diagnosis at this stage. In some clinical contexts, such as diabetic foot ulcers, decubitus ulcers, back pain and fever, the visualization of BMEP is highly predictive of intra-osseous spread of infection and has obvious implications for patient management. The presence of BMEP is also a key feature for the diagnosis of stress fractures and bone-on-bone impingement (osteochondromas, hypertrophic bone callus, wrist and ankle impingement syndromes). When conventional CT is inconclusive, a complementary imaging method, usually MRI or scintigraphy, has to be performed to reach diagnosis³. The use of DSA-like bone subtraction algorithms can help identify areas of BMEP on CT scans which can expedite the diagnosis, since in many of these cases CT is the first evaluation method employed. The ability to detect BMEP on CT also increases the diagnostic possibilities when MRI is not available (pacemaker, cochlear implants, agitated or claustrophobic patients).

Localization of occult bone lesions

Multiple benign and malignant conditions may present as a non-lytic, non-sclerotic bone lesions which are not identifiable on conventional CT. The identification of an intra-osseous enhancing lesion is of significant clinical importance because this finding may be related to early metastatic disease or aggressive bone tumors. Although CT with bone subtraction is not a screening tool, CT is performed in a wide set of clinical situations and the ability to detect this type of bone lesion may be important for patient management. As with all current CT acquisitions, subtracted images can be reformatted in any plane, which in our experience offers a welcome aid in the planning and execution of CT guided bone biopsies.

Characterization of lytic bone lesions

Bone tumors occur frequently as non-specific lesions on imaging. The diagnosis in these tumors relies on invasive procedures (percutaneous or surgical biopsy) for the histologic confirmation of the lesion's nature. Relatively few lytic bone lesions are known to be associated with BMEP on the adjacent bone marrow, which acts in these cases as a distinguishing feature. This is the case for osteoid osteomas, osteoblastomas, chondroblastomas and eosinophilic granulomas⁴. DSA-like bone subtraction adds the possibility of using conventional CT to non-invasively diagnose these lesions, sparing the patient additional invasive diagnostic tests.

Local staging of lytic bone lesions

Aggressive bone lesions may demonstrate microscopic invasion of the bone adjacent to its margins. The non-invasive differentiation between tumor invasion and reactive bone change is difficult and sometimes impossible since both of these anomalies are associated with abnormal enhancement in non-lytic bone adjacent to a bone mass⁴. Accurate local staging is one of the cornerstones of curative surgical resection of bone tumors. DSA-like bone subtraction can demonstrate enhancement adjacent to an aggressive bone lesion assisting in accurate local staging. Additionally this technique may have a potential role in association with other MR based imaging techniques in the characterization of peritumoral anomalies.

Assist perfusion analysis

(ROI placement) when performing

CT perfusion of bone lesions

With the major dose reduction offered by new developments in CT technology, mainly related to better and larger detectors and iterative reconstruction algorithms, CT perfusion can now be used in a wider range of clinical applications. This is particularly true for the upper and lower limbs, where the tissue sensitivity to radiation is very low with a resultant low effective dose. CT perfusion of bone lesions can be difficult because of the adjacent high density bone. Although contrast enhancement in non-lytic bone is measurable on CT perfusion it cannot be seen. How can you measure something you cannot see? Where should you place the ROI? Bone subtraction is of great assistance in these cases. Once subtraction allows the enhancing area to be visualized the ROI can be correctly placed increasing the accuracy of CT perfusion results.

Conclusion

The use of CT scanners with a wide detector design offers the possibility of DSA-like bone subtraction, which has many potential applications in the evaluation of musculoskeletal disorders. This technique helps locate, characterize and stage malignant and benign bone lesions. It also has an important role in CT perfusion of bone tumors, assisting in the selection of the region to be analyzed. Enhancement in a non-lytic bone lesion may have major diagnostic implications and is currently evaluated by MRI. DSA-like bone subtraction increases the diagnostic power of CT in various clinical situations helping reach a conclusive or highly probable diagnosis for patients with musculoskeletal disorders.

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Whole Organ Perfusion of the Pancreas Using Aquilion ONE

J. J. Hermans

Introduction

Aquilion ONE /VISION Edition, which has been introduced at the RSNA 2012, brings us a fundamentally new way to use a computed tomography (CT) scanner. With its fastest rotation time of 0.275 ms and z-coverage of 16 cm this state-of-the-art scanner provides us and our patients with robust clinical solutions every time. Not only produces Aquilion ONE /VISION Edition the highest diagnostic image quality with the lowest possible radiation exposure it also offers new clinical solutions, like dynamic imaging and whole organ perfusion. This new CT scanner allows us to scan dynamically with uniform (xyz) temporal resolution of 137.5 ms and 16 cm volume coverage: from morphological to physiological diagnosis. Only few studies have been published about CT perfusion of the pancreas, partly due to the small volume of coverage with previous scanners. Aquilion ONE /VISION Edition makes it possible to scan an entire organ such as the pancreas.

During free breathing of the patient multiple sequential time points are acquired to obtain a tissue concentration curve. The time interval between acquisitions is small in the arterial phase (circa 2 seconds), is larger in the parenchymal phase (circa 3 seconds) and increases to 1 minute in the late venous phase (Fig. 1).

Because of movement of the pancreas in the z-axis during the acquisitions, the obtained high resolution perfusion images are registered with a sophisticated non-rigid algorithm, using one volume with maximal enhancement as a reference scan. Subsequently, perfusion maps can be calculated based

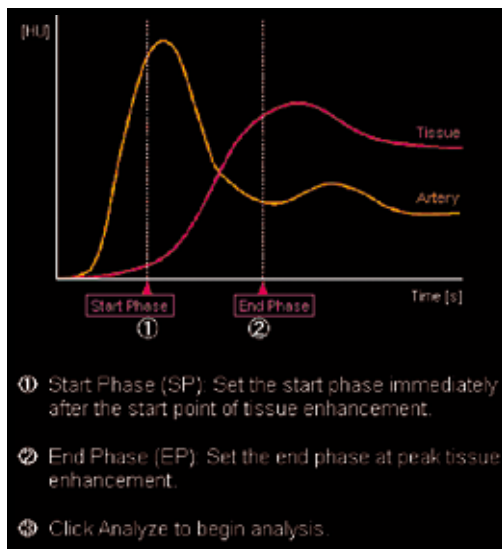
on different models, i.e. maximum slope and patlak plot. These models have different requirements and produce different outcomes. The maximum slope is a linear approach which computes the perfusion values based on the maximum slope of the arterial time curve showing the arterial flow of the organ in ml/min/100ml. The Patlak plot relies on the back-flow of contrast medium from the extravascular to intravascular compartments. The exchange of contrast between blood and tissue is then calculated on the Patlak plot, which uses linear regression to analyze contrast uptake in tissue.

Patient history and diagnosis

A 64-year-old man with vague abdominal pain was presented at our hospital after a transabdominal ultrasound showed a hypoechoic mass of about 4 cm in the uncinata process of the pancreas. C-reactive protein, liver function tests, amylase, Hb and leukocytes were all within normal range. Because of this finding the patient was analyzed within a fast track protocol for workup of pancreatico-biliary disease. After written informed consent was obtained the patient participated in a study on CT perfusion of the pancreas and liver. The CT perfusion images were registered and the tumor in the pancreas was subsequently analyzed according to the maximum slope model and the Patlak model. With both models a 4-5 cm mass was shown in the head of the pancreas without obstruction of the common bile and pancreatic duct. The mass showed a large nonperfused center. Towards the periphery of the tumor the perfusion gradually increased to normal pancreatic

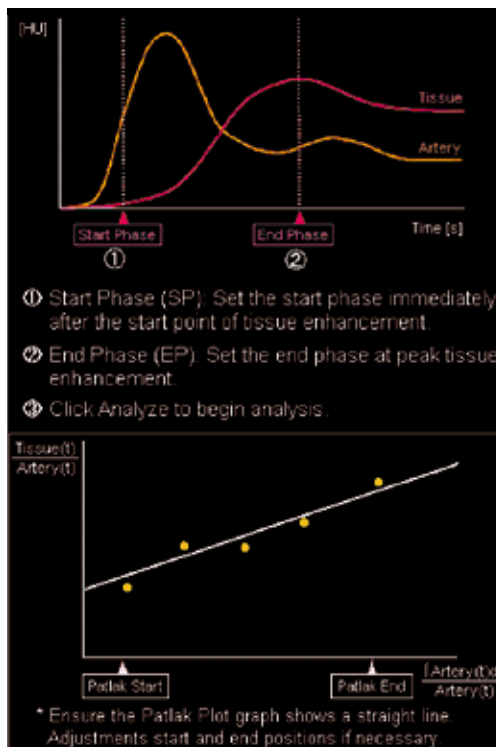
Fig. 1: Time sequence protocol





Max. slope

Fig. 2: Two different models: maximum slope and Patlak plot



tissue. For perfusion analysis of the liver a dual input model was used which showed a small hyperperfused lesion of 5 mm in the caudate lobe and a small non-perfused lesion of 5 mm in segment six of the liver. On T2-weighted TSE and post-contrast MR images the lesion in the caudate lobe showed characteristics of a metastasis and the lesion in segment six of a cyst. On MRI four more metastases in the liver cupola were detected. Because the pancreatic tumor was positioned rather caudal in the pancreas, the liver could not be completely covered within the 16 cm dynamic volume. Therefore these metastases high in segment four and eight could not be analyzed for perfusion characteristics. Because of the presence of liver metastases a curative resection of the primary pancreatic tumor was no longer feasible. To obtain a definitive diagnosis an endoscopic ultrasound (EUS) was performed which showed a multicystic mass with solid components

in the pancreatic head. FNA from the solid components demonstrated malignant cells belonging to a carcinoma of the pancreas.

Comments

Quantitative analysis of tissue microcirculation can possibly be used for biological characterization of solid pancreatic tumors and for evaluation of response to chemotherapeutic agents and/or radiotherapy. In the future perfusion parameters might be used to predict tumor aggressiveness and/or to design an individually tailored therapeutic approach.

Fig. 3: A small lesion in segment six of the liver with high signal intensity on a coronal HASTE image without contrast enhancement in the late venous phase, characteristic of a small cyst

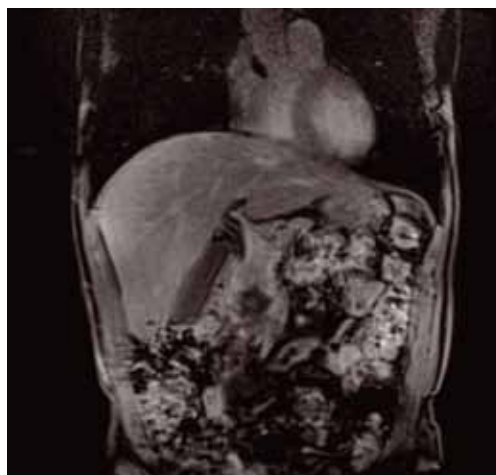
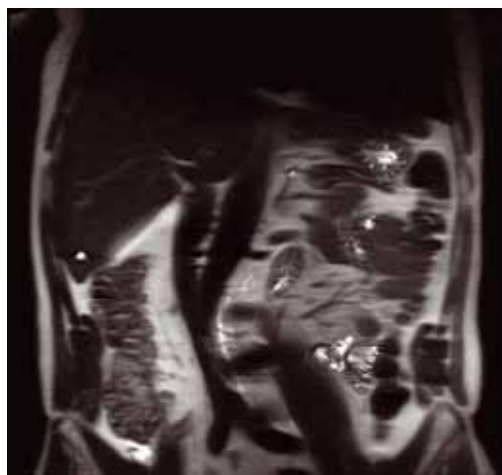


Fig. 4: Small lesion in the base of the caudate lobe with increased signal intensity on T2-weighted TSE with fat suppression image and rim enhancement in the late venous phase, characteristic of a metastasis

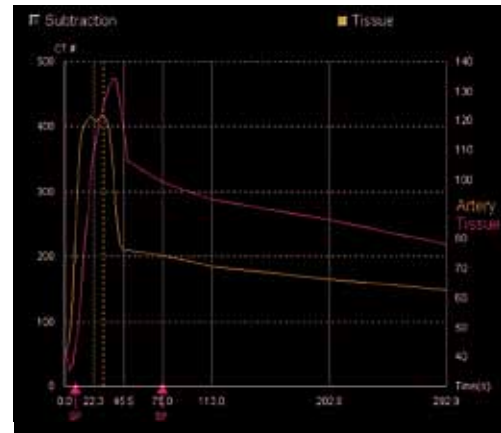
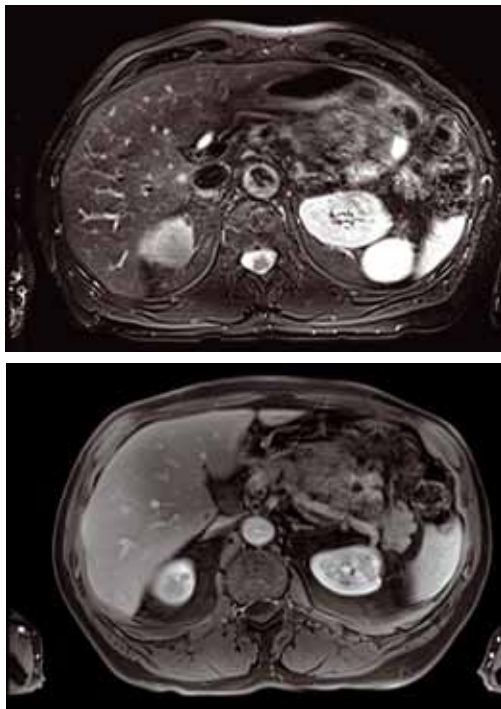
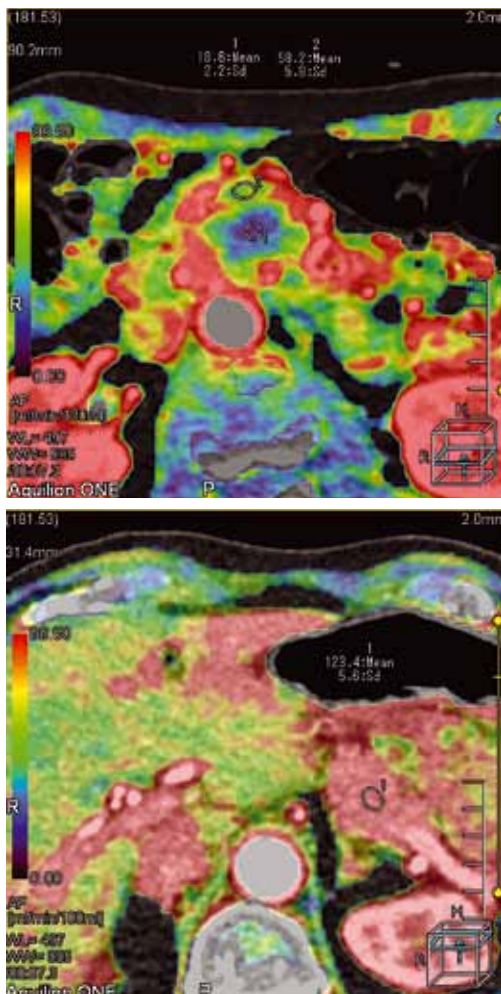
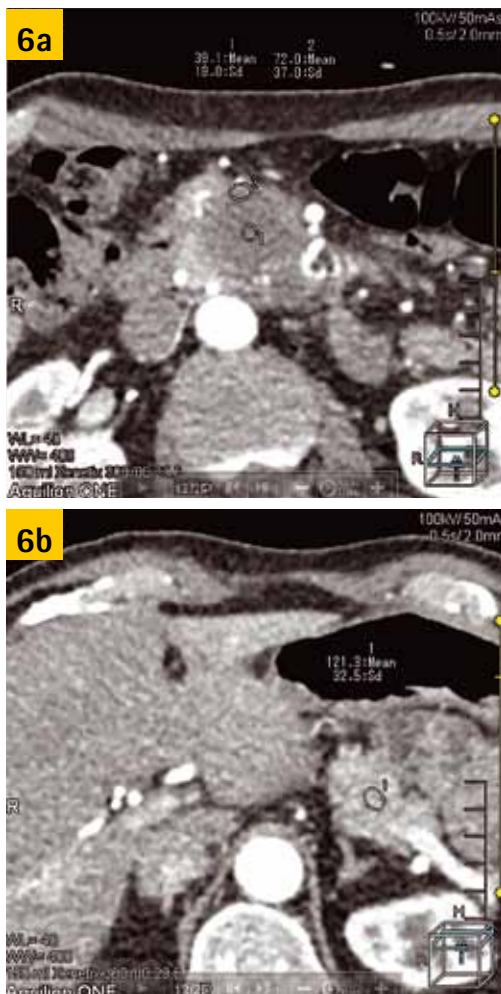


Fig 5: Shows the enhancement curve in the aorta (artery) and in the pancreas tail (tissue)

Fig. 6: Maximum slope model
 a) contrast-enhanced CT image of a large tumor in the pancreatic head.
 b) Perfusion map of the tumor with ROI1 in the central necrosis and ROI2 in the enhancing rim



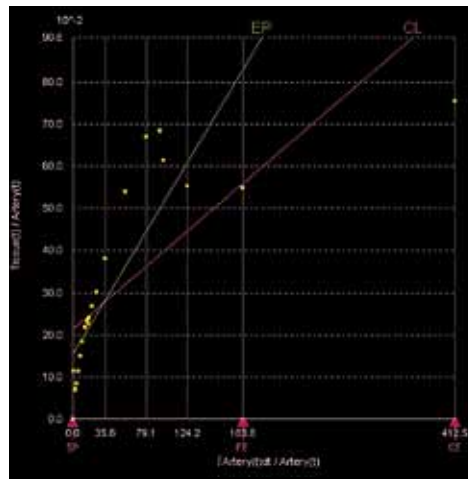
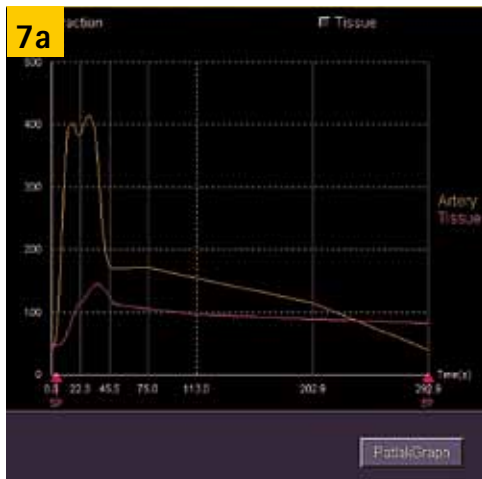


Fig. 7: Patlak graph before (a) and after (b) adjustment of start point (SP) and end point (EP)

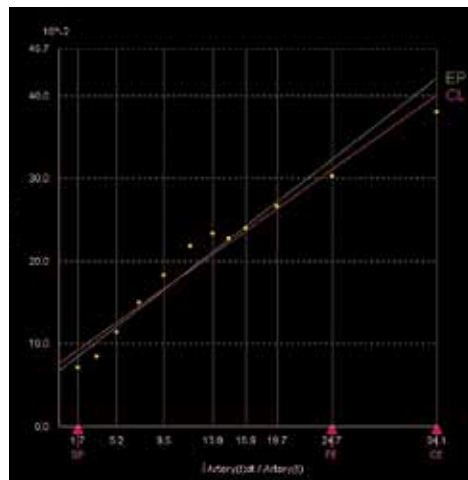
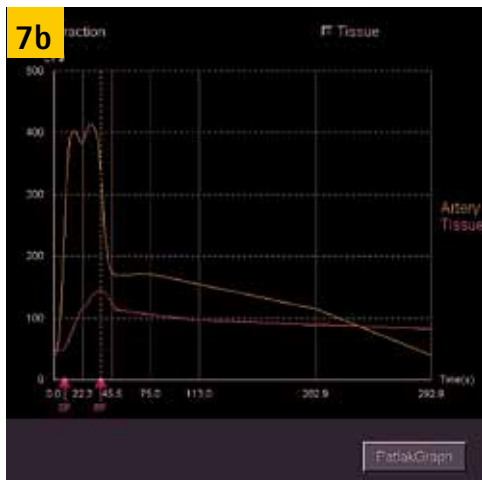
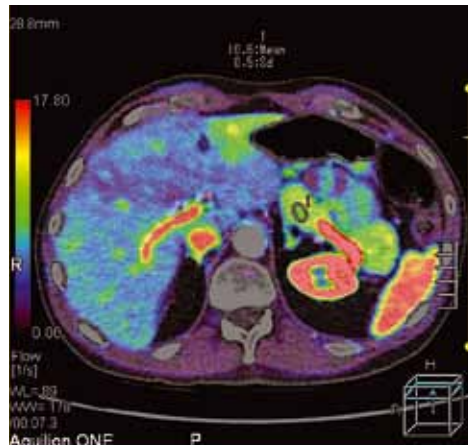
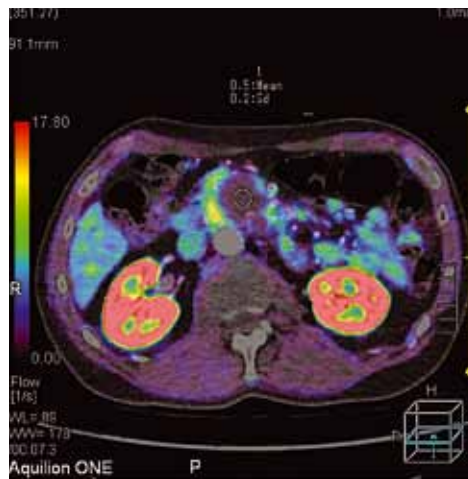
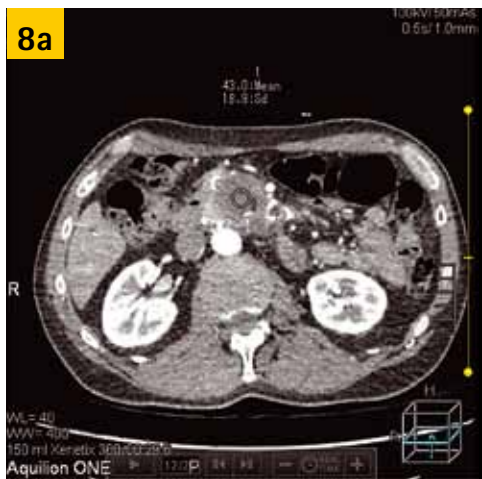


Fig. 8: Patlak model
 a: perfusion map of a large tumor in the pancreatic head with central necrosis (ROI 1) with a rim of enhancing tumor tissue
 b: perfusion map of the normal pancreatic tail (ROI 1)



Breaking New Ground in Scanning Innovation

Bradford Teaching Hospitals gains the first new generation Aquilion PRIME

Nigel Lewis is Clinical Services Manager and Head of Profession at Bradford Royal Infirmary, one of the UK's most respected centres for radiology. The hospital has recently acquired an Aquilion PRIME CT scanner for his multidisciplinary team. The state-of-the-art technology installation means that Bradford Royal Infirmary becomes a world reference centre for the most advanced CT scanning equipment available today.

VISIONS magazine travelled to Bradford to talk with Nigel Lewis and his team to find out more about the installation of the first new generation Toshiba Aquilion PRIME CT scanner and his team's experiences with it, during and since installation in January this year.

VISIONS: Why did you invest in the Aquilion PRIME?

Nigel Lewis: It is an unusual situation in that we were acquiring the first new generation Aquilion PRIME CT scanner. The Bradford Teaching Hospital Trust had already invested in an Aquilion ONE scanner in 2012 for St Luke's Hospital. We really wanted a very high specification scanner that would efficiently and effectively execute a throughput of work across a wide variety of areas including cancer staging, MSK, cardiac CT, CTCs all the way

“Nigel Lewis: “With regard to the technology we can't compare it with anything else as its a new generation of equipment.” ”

*With the new
Aquilion PRIME
Bradford Royal Infirmary
becomes a world
reference centre for the
most advanced CT
scanning equipment
available today*



Jonathan Barber (left) and Nigel Lewis were really impressed about the system set up and installation

through to advanced neuro imaging. We were also very interested in the shuttle helical function for brain and future developments for body perfusion scanning. Ultimately, we were looking at spending a significant amount of money for the best technology available. We needed to ensure it was future-proofed for up to 10 years.

What really caught our attention was its smaller footprint combined with its large diameter bore of gantry, which enhances the patients experience as they don't feel so claustrophobic. Additionally the applications packages like InstaView and Hybrid View with fast reconstruction are easily integrated with our protocols and workflows.

VISIONS: How closely did you work with the Toshiba team prior to, and during installation?

Nigel Lewis: I think we have a very special relationship with Toshiba. We have had a very positive experience previously with the installation of the Aquilion ONE at St Luke's. Right from the very start, Toshiba Japan, together with the UK team were heavily involved in the installation, acceptance testing, setting up of protocols and from the outset of scanning procedures. We look at it going forward as a real partnership that helps us get the best out of the technology for the hospital and its patients, but



“Jonathan Barber: “We have been very impressed with the Aquilion ONE and believe that the Aquilion PRIME will develop our examination expertise even further.””

also helps Toshiba in helping define future developments of its scanning platforms.

The ongoing support from installation onwards saw a team of five consultants from Toshiba including the machine technicians, software engineers





The Bradford Royal Infirmary, one of the UK's most respected centres for radiology

examinations that we cannot currently offer. We will realise real advances for brain perfusion, body perfusion and for some of the dual energy applications, like stone characterization, that we are planning to design with Toshiba's help. Ultimately we'll be able to complete a full scan, quickly and effectively and get the patient moving faster towards treatment and recovery.

“ Anne Williams: “We are increasing the number of patients per session and reducing contrast dose by at least fifty percent.” ”

and applications specialists on site throughout installation and 'going-live' period.

Jonathan Barber, Consultant Radiologist and Divisional Director for Clinical Support Services: It's incredibly exciting. We have a very good relationship with Toshiba that is based on great experiences with the technology and the service and support. We've been very impressed with the Aquilion ONE and believe that the Aquilion PRIME will develop our examination expertise even further.

VISIONS: What has impressed you about the system set up and installation?

Nigel Lewis: Firstly, I think the installation was very impressive, the fact that it was a new scanner and the support that was made available to the Trust both in protocol design, selection and building and in the actual applications training for the staff. I think it's over and above what we have experienced before.

With regard to the technology, we can not compare it with anything else as it is a new generation of scanner. Aquilion PRIME will enable us to increase patient throughput and to develop our scanning capabilities with body perfusion and dual energy capabilities.

VISIONS: What benefits have been realized with the system in place?

Nigel Lewis: Over the coming months our capacity will increase. The scanner is obviously faster than anything we have been used to so that will realise extra capacity and patient throughput. More importantly, we can actually plan forward and offer

Anne Williams, CT Advanced Practitioner and Team Leader: The scanning and table movement is extremely quick and the design is extremely intuitive, which means that our staff can get to grips with the best technology very quickly. We are increasing the number of patients per session and reducing contrast dose by at least fifty percent compared to previous scanners we have used.

VISIONS: Finally, what are your hopes for the system over the next year? What results do you hope to achieve and how will you measure success?

Nigel Lewis: We hope to demonstrate that the new Generation Prime has significantly contributed to our scanning capacity and the development of advanced scanning protocols, whilst being mindful of the complexity of examinations and the patients experience through access to this new technology.

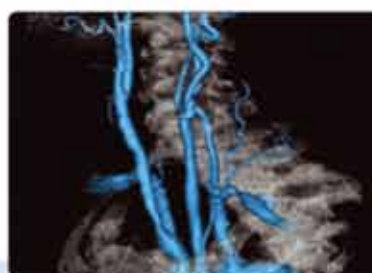
We are also looking forward to seeing the staff training and development at the same speed of technology innovation, both for scanning applications and for reporting.

It will definitely raise our profile as a world reference centre and we're looking forward to being the first to see developments on the platform. We have a very good equipment base with our Aquilion PRIME and Aquilion ONE technology and look forward to continuing to develop our clinical service to the benefit of both the patients and staff.

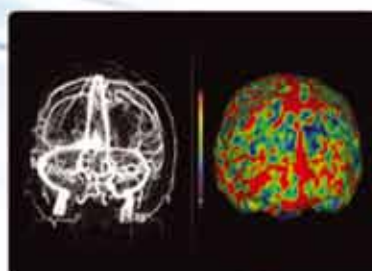
VISIONS: Thank you very much for your time. We look forward to catching up again to find out what the partnership achieves over the next year.

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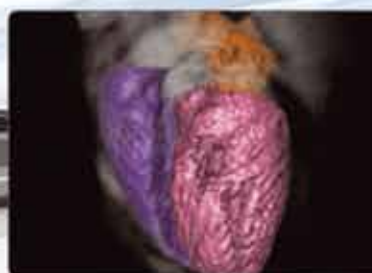
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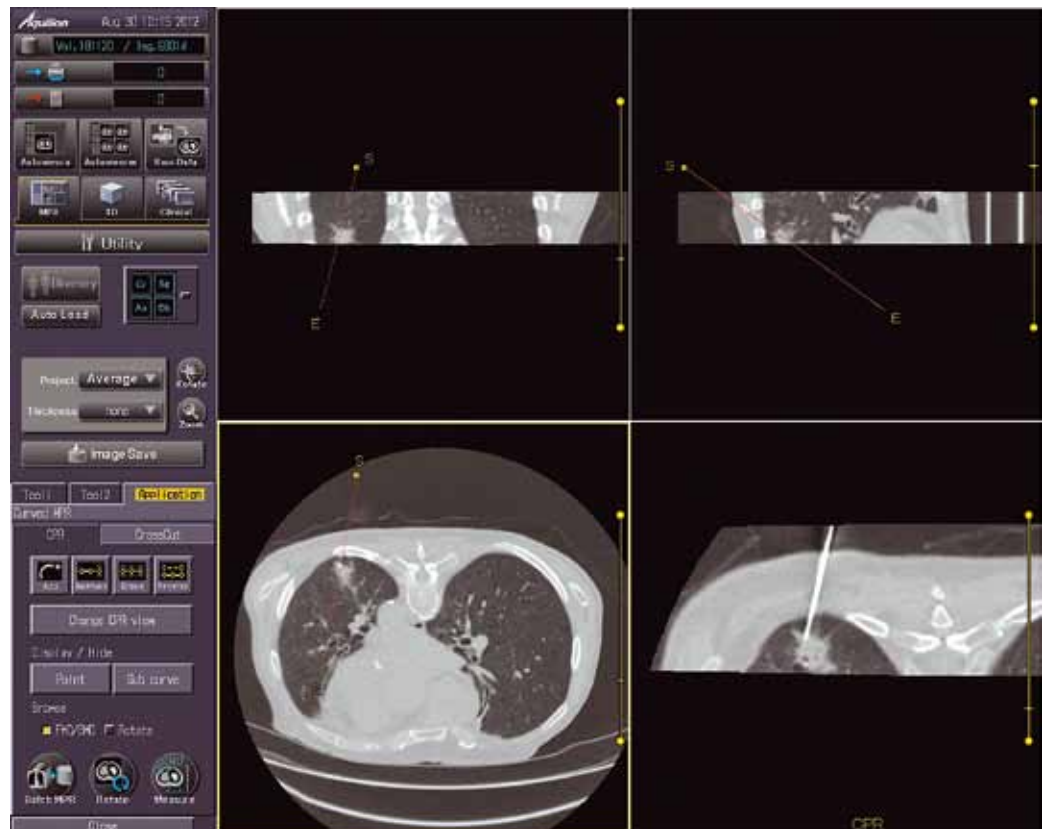
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VITAL

A Toshiba Medical Systems Group Company

Initial Clinical Experience with 3D Interventional Software

E. Kotter



Introduction

Due to its excellent low contrast and high spatial resolution CT has a long history of being the modality of choice for complex biopsy procedures. While CT fluoroscopy (CTF), introduced by Toshiba in 1994, made procedures faster and safer the recent launch of 3D interventional software is a further major advance in CT-guided biopsy techniques.

Complex biopsies often require a needle approach which traverses through the scan plane, making needle paths more difficult to track. True 3D interventional software, made available on the Aquilion ONE, helps tackle even the most challenging biopsy procedures and thus offers real clinical benefits. Remarkably enough low dose parameter settings can be maintained as the use of AIDR 3D is accompanied by only a very minor penalty in reconstruction time.

Basic principles

Toshiba supports three modes of CT fluoroscopy that cover a wide range of interventional procedures.

1. Continuous 3-slice fluoroscopy
2. One shot 3-slice scan
3. 3D interventional software

Continuous 3-slice scan mode permits instrument tracking in real-time, much like conventional fluoroscopy. This mode is frequently chosen for biopsies of lesions that are prone to physiological movement.

One shot 3-slice scan mode provides three consecutive images with full resolution and requires considerably less dose and thus less exposure for patient and staff.

3D interventional software provides an isotropic 0.5 mm single exposure volumetric scan of up to 16 cm and is displayed in MPR. This technology allows the accurate planning and tracking of the needle path in oblique and double oblique orientation with excellent spatial orientation and excellent tracking targets with a low dose technique.

Case study

A 78-year-old male with a spiculated lung mass in the supero-posterior portion of the left lower lobe presented for core biopsy. A low dose ultra-helical scan to localize the lesion was performed (Fig. 1) with the patient in prone position.

In a next step the volume reconstruction of the ultra-helical scan was loaded into the 3D interventional program and automatically displayed in MPR for planning purposes. Fig. 2a shows that the lesion is situated directly behind the 8th rib requiring an oblique approach through the 7th and 8th intercostal space (see Fig. 2b).

A reduced scan range in 3D interventional software was used to track the needle path in orthogonal and oblique imaging planes. The needle was positioned correctly in the lesion after only two exposures (Fig 3).

A core biopsy was performed and histological analysis confirmed a lung carcinoma.

Initial clinical experience

At our clinical institution, we schedule on average twelve biopsy procedures per week. Since the introduction of 3D interventional software we have noticed a remarkable reduction in the time it takes to perform most interventions. In addition, interventional radiologists carry out the increasingly complex biopsy procedures with much more confidence. True 3D image display no longer requires us to create a 3D "mind's eye" view of patient anatomy. Direct and accurate visualization is provided in axial, coronal, sagittal and oblique planes. The 3D interventional tool is now used exclusively for our CT interventions and has proven to be an excellent aid for our radiology residents to quickly gain confidence and expertise.

Conclusion

Toshiba's 3D interventional software, available on the Aquilion ONE and Aquilion PRIME systems, offers real-life clinical advantages for interventional CT procedures. Examinations can be performed faster and with a higher degree of accuracy.



Fig. 1: Ultra-helical scan of whole thorax to localize the lesion



Fig. 2a: Lesion is situated directly behind the 8th rib



Fig. 2b: Oblique planning through the 7th and 8th intercostal space

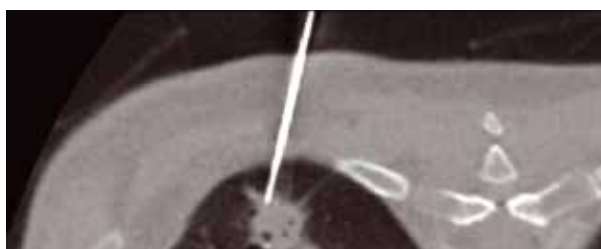


Fig. 3: Oblique reconstruction clearly showing the position of the needle in the periphery of the lesion

Vital Signs Landmark Deal with Skåne University Hospital

Skåne University Hospital has emerged as one of the leading medical institutions in Scandinavia, a reputation enhanced through the bold and innovative step to merge the two university hospitals of Malmö and Lund under one management team.

This decision, taken by the regional council late in 2009, has enabled Skåne University Hospital to move forward in offering ground-breaking medical care and innovation to the population of Sweden it serves.

One area where the hospital is at the forefront of care is in radiology, diagnostics and imaging, with its use of the latest technology and systems.

That took on a new dimension recently with the hospital becoming a landmark customer for an important global healthcare IT provider.

Vital Images, a Toshiba Medical Systems Group Company and leading provider of advanced visualization and analysis solutions for physicians and healthcare specialists, signed Skåne University Hospital Malmö as its 5,000th healthcare IT and advanced visualization solutions customer.

With software utilized in hospitals in more than 100 countries, Vital is now supplying solutions to Skåne University Hospital to help enhance the patient experience across the region of Skåne.

The company's VitreaAdvanced software forms part of Vitrea Enterprise Suite and combines best-of-breed 2D, 3D and 4D clinical applications and world-class services with a centralized solution for managing volumetric image data across the medical enterprise all accessible via the Web. The solution offers advanced applications for cardiovascular, neurovascular and oncology, and offers integration with PACS in a few simple clicks. VitreaAdvanced addresses the challenges of managing multiple disparate advanced visualization systems and is designed to improve performance and productivity, ensure scalability and redundancy. The system does not require proprietary hardware, allowing users to utilize their existing infrastructure. Skåne University Hospital was attracted to the level of accessibility and performance offered by VitreaAdvanced.

Vital Images also offers VitreaView, which is a universal viewer that provides physicians with universal access through a simple intuitive user interface for patient imaging. It offers secure integrated access to imaging through EMR, EHR, or HIE and also enables access to images from disparate databases, providing one integrated universal viewer. Institutions deploying VitreaView provide standardization and access for medical professionals, enabling them

Lars Bååth, Associate Professor at Skåne University Hospital Malmö meets with Satoshi Tsunakawa, President and Chief Executive Officer, Toshiba Medical Systems Corporation and the Toshiba Team at RSNA.



to optimize their time and focus on patient care.

Institutions deploying VitreaView provide standardization and access for medical professionals, enabling them to optimise their time and focus on patient care. It was this level of accessibility and performance which attracted Skåne University Hospital to the company.

Lars Bååth, Associate Professor and head of the clinical department for radiology at the hospital, said: "Skåne University Hospital Malmö made the decision to purchase the Vital solution after months of thoughtful consideration and evaluation of all the leading solutions in the market.

"We are confident that the solution will exceed the requirements we set forth and look forward to a meaningful partnership with Vital."

The solution Skåne University Hospital has purchased which will facilitate post-processing of 4D angiography of cerebral vessels; easy and automated post-processing of CT perfusion of the brain; and easy volume measurements such as measurement of the volume of cerebral haemorrhages and infarctions as well as brain tumours.

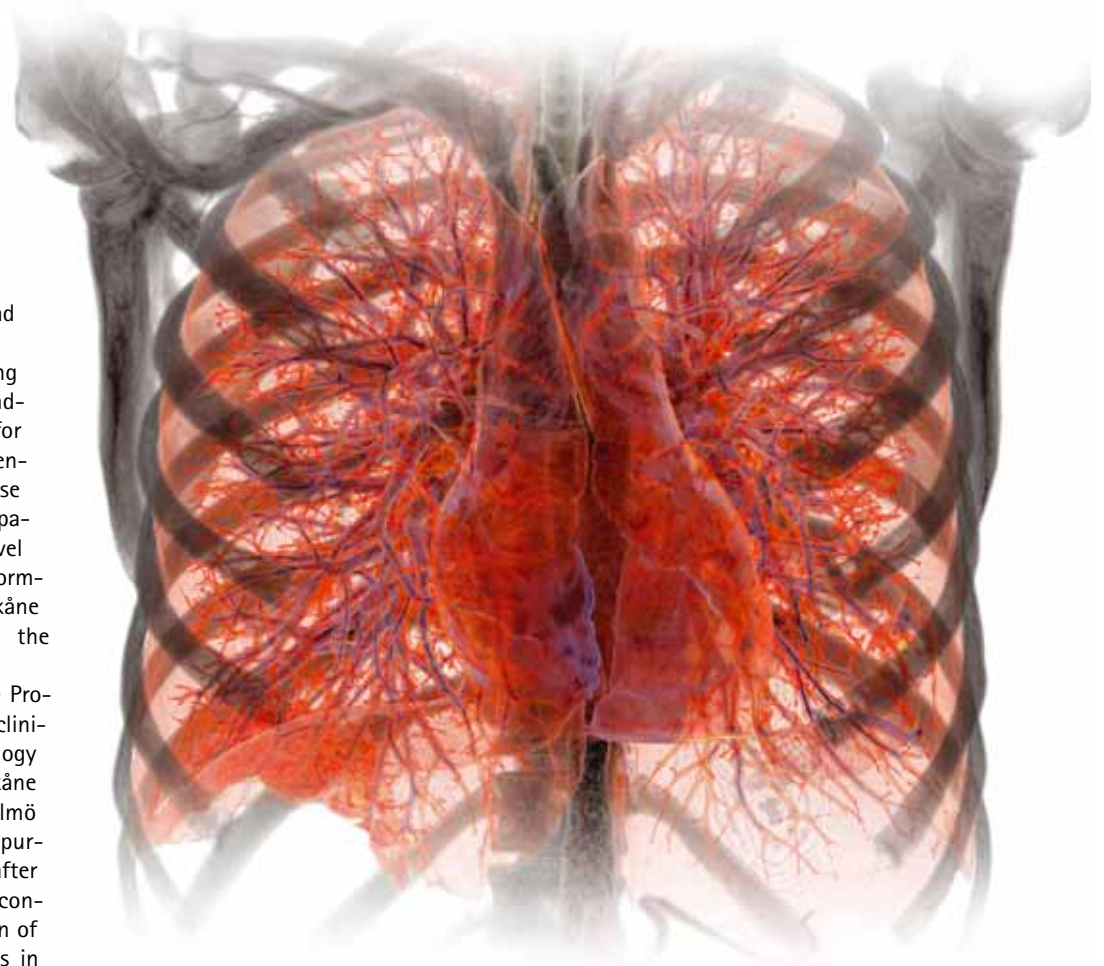
Professor Bååth said a major factor in choosing the Vital solution was because the system afforded "the possibility of different post-processing that are almost automated, rapid and easy to handle."

He added: "As we purchased the Vitrea licenses incorporated in our PACS, it enables us to pick up the patient in question from PACS at any work station in the department, perform the post-processing and save snapshots, batches or videos and send them to PACS for presentation at clinical conferences.

"It enables us to perform different measurements and analysis within the system such measurements of different cerebral blood perfusion parameters, degree of internal carotid artery stenosis, and evaluation of plaque morphology."

He said because the solution offers automated/semi-automated post-processing software that is easy, logical and robust, it will save the radiologists time, especially in an emergency situation that needs rapid decision making.

Patients will also benefit from the rapid delivery of radiology reports as the post-processing is extremely easy and automated.



"It also enables measurements of values our available system do not offer e.g. absolute values of cerebral blood flow," added Professor Bååth.

Vital is equally delighted to be partnering Skåne University Hospital and see the institution becomes its 5,000th customer.

Erkan A. Akyuz, president and chief executive officer at Vital, said: "We've had many notable milestones since Vital's inception in 1988, including introducing one of the first ever advanced visualization solutions to the market and, more recently, the notable Toshiba acquisition last year.

"Partnering with our 5,000th customer is a milestone we are particularly proud of, as it reflects the adoption of the solutions we develop as well as the commitment our employees have to customers and their patients."

Vital continually invests in programs and technology designed to enhance relationships between customers, referring physicians, partners and patients. Building on its knowledge and understanding of complex clinical workflow, Vital offers a comprehensive suite of enterprise-wide advanced visualization and connectivity solutions.

The merger of the two university hospitals in Malmö and Lund came into effect on January 1, 2010, enabling the strengthened clinical research and the university healthcare service in Skåne to gain increased competitiveness from a Swedish and international perspective.

The hospitals in Lund and Malmö have a long history and have been operating side by side since the latter part of the 19th century. The infirmary in Lund,

which is one of the country's oldest hospitals, was established as early as 1768.

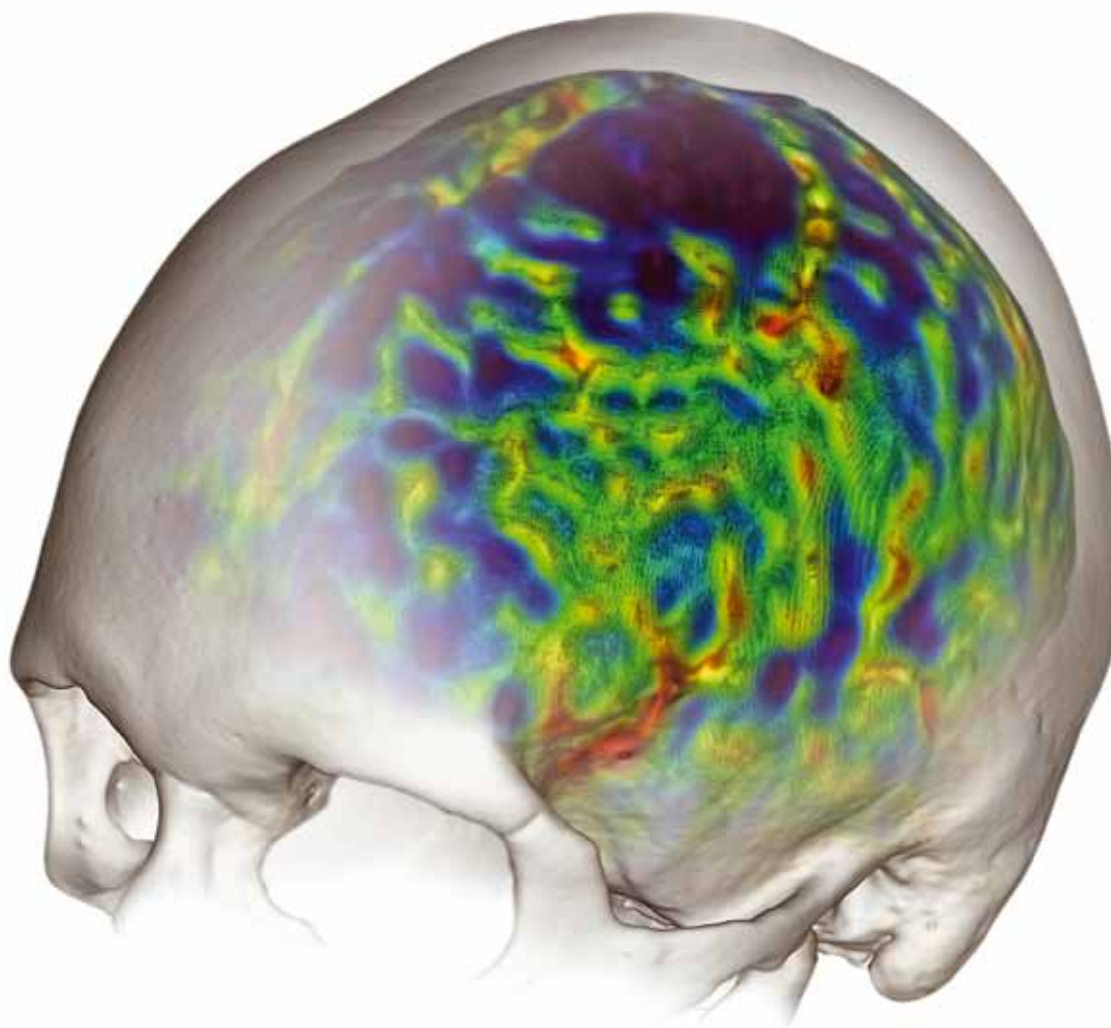
Both hospitals started off with a few beds and then grew in size over the years to meet rising patient demand.

Research and training are important elements of what goes on at Skåne University Hospital, which is the third largest of Sweden's seven university hospitals. Its three cornerstones are advanced medical care; training; and prominent research and it has one of the largest emergency medicine hospitals in Sweden.

Major investments have been made in the hospital campuses in Malmö and Lund in recent decades, which have created an excellent environment for research scientists, students and care personnel.

Questions and experience from meetings with patients at the clinic are brought into the laboratory with the research results fed back to the patients in the form of new improved methods of diagnosis and treatment, new drugs and new techniques.





The 780-bed Skåne University Hospital has 11,700 employees, with an annual budget of SEK 10 billion. On an average day at Skåne University Hospital: 24 children are born; 350 patients visit its two emergency departments; 151 patients have surgery; there are 1,327 inpatients; 915 patients are X-rayed; six scientific articles are published; and SEK 28 million are consumed.

Its radiology department carries out about 400,000 diagnostic exams a year, the lion's share of the 900,000 radiology examinations conducted annually by the 10 hospitals of the region.

Within the Skåne region today, there is a unity in the equipment that the hospitals' radiology departments use. All access the same and have implemented a cross-enterprise solution for distributed radiology cooperation within and outside the region independent of the supplier of RIS or PACS.

By linking the hospitals' radiology operations in a single shared RIS/PACS solution, an efficient flow of images and information was created throughout the region.

Its infrastructure supports automatic sharing and distribution of radiology information to all departments involved in the radiology workflow.

With the latest partnership with Vital, Skåne University Hospital is moving its care in radiology, diagnostics and imaging onto yet another level.

Skåne University Hospital's key milestones

The year 1768 saw the foundation of the Lund Infirmary and in 1857 Malmö's general hospital in Slottsgatan was established, with an annex at Jakob Nilsgatan. In 1948, the Swedish government agreed to allow Malmö General Hospital to carry out clinical teaching.

In 1989 the Medical Research Centre (Lund University) was inaugurated and in 1993 the Lund Infirmary changed its name to University Hospital in Lund while Malmö General Hospital (MAS) changed its name to the University Hospital MAS in 1994.

In 2004 the Diagnostic Centre – one of the world's most modern departments for medical imaging, was established in Malmö, in 2006, there was the inauguration of the CRC, the Clinical Research Centre (Lund University) building and in 2008 Region Skåne's Competence Centre for Research (RSKC) formally opened, creating new opportunities for advanced research on the basis of a central biobank department.

Meanwhile, 2010 saw the merger of the University Hospital in Lund and the University Hospital in Malmö to form Skåne University Hospital and in 2012 Skåne University Hospital became the 5,000th healthcare IT and advanced visualization solutions customer for Vital.

Neuro-Microvascular Imaging at 1.5T Using the Flow Sensitive Black Blood Technique

F. Admiraal-Behloul



Faiza Admiraal-Behloul

Introduction

Cerebral magnetic resonance angiography (MRA) at 1.5T is generally limited to the time-of-flight (TOF) technique which is most widely used for the visualization of macrovasculature in intracranial arterial diseases. The TOF technique at 1.5T has spatial and contrast resolution limitations for visualizing slow-flow arterial branches mainly because of spin saturation and relatively short T1.

Current neuro-imaging techniques based on computed tomographic angiography or digital subtraction angiography have been used to investigate vascular pathophysiology. However, the study of microvascular diseases in vivo has been restricted by their inherent invasiveness.

Lenticulostriate arteries (LSAs) are one of the most important microvascular structures in the human brain as they supply blood to the basal ganglia (Fig. 1) where ischemic and hemorrhagic cerebral strokes often occur. The LSAs are end arteries that have little or no collateral circulation.

LSA branches can be clearly observed using digital subtraction angiography, though this technique is invasive. Recently, LSA branches have been successfully visualized with 7T MR imaging by using time-of-flight MRA^{1,3}. Some relationships between decreased LSA visualization and hypertension or infarction at the basal ganglia and/or its vicinity were demonstrated³. However, the availability of 7T MR imaging systems is very limited, and they are currently used for research purposes only.

There is a great need for imaging the microvasculature in the brain for the early detection of cerebrovascular strokes in routine clinical practice and for research purposes. However, the literature agreed that non-invasive imaging of cerebral microvasculature such as the LSAs requires ultra-high MR field strength (7T) and could not be realized at lower field strengths (1.5T nor 3T)¹⁻³.

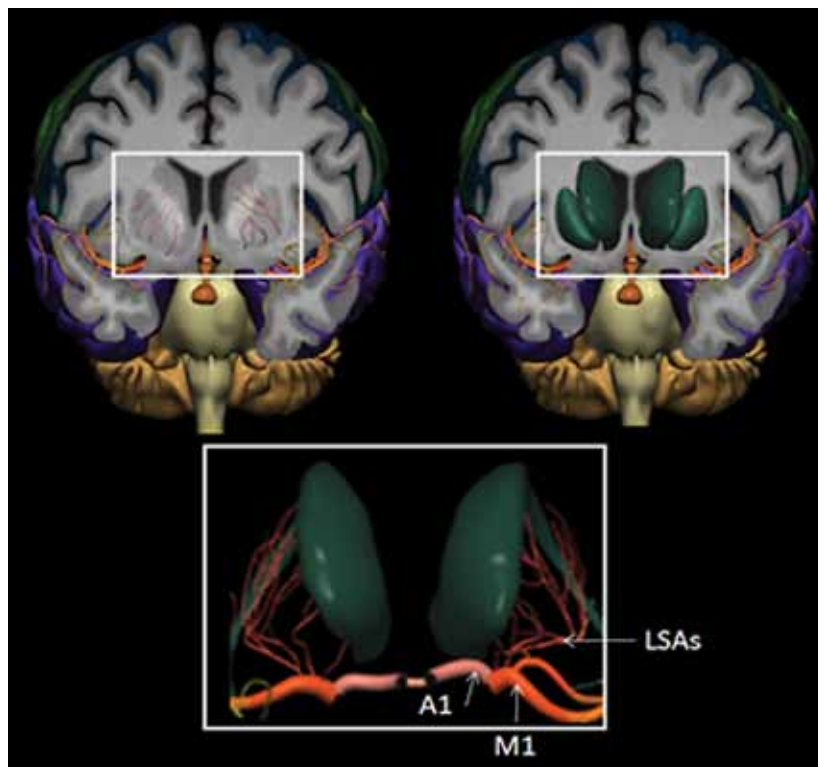


Fig. 1: Lenticulostriate Arteries anatomy. The horizontal M1 segment gives rise to the (lateral) lenticulostriate arteries which supply part of head and body of caudate, globus pallidus, putamen and the posterior limb of the internal capsule. Often the medial lenticulostriate arteries arise from the A1-segment of the anterior cerebral artery.

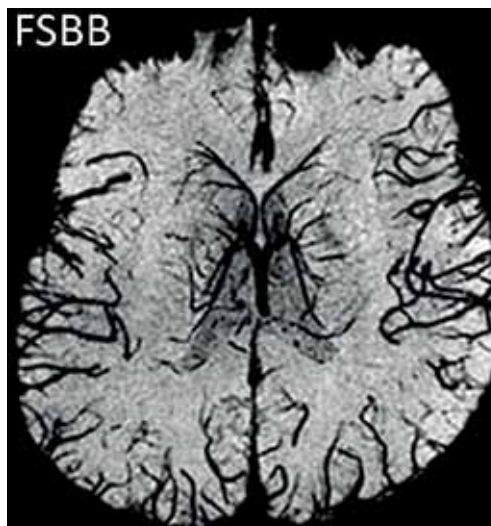
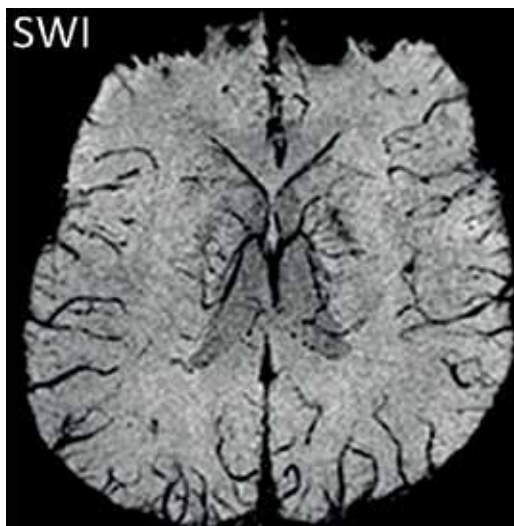


Fig. 2: Comparison between minIP SWI image (left) and minIP FSBB image (right) in a healthy volunteer scanned at 1.5T. Note the increased vessel/parenchyma contrast in FSBB.

Flow sensitive black blood imaging

FSBB is a high resolution 3D gradient echo technique which, unlike Susceptibility Weighted Imaging (SWI), uses a weak Motion Probing Gradient (MPG) pulse that dephases the water signals of the flowing blood and has no effect on the water signal in stationary tissues^{4,5}.

SWI is based on high resolution, three-dimensional (3D), fully velocity-compensated gradient-echo sequences using both magnitude and phase images. A phase mask obtained from the MR phase images is multiplied with magnitude images in order to increase the visualization of the smaller veins and other sources of susceptibility effects. The images are then displayed using the minimal intensity projection (minIP). Because the image contrast in SWI is mainly based on the susceptibility effect SWI is more successful at high (3T) and ultra-high (7T) field strengths. Furthermore, phase disturbance is observed mainly in the vein and therefore not suitable for arterial microvasculature imaging.

With FSBB the signal from rapidly flowing blood is attenuated by applying a very weak MPG for signal dephasing, which mainly attenuates the signal from rapidly flowing blood in the artery, while the signal from stationary or slow-moving components is not or much less affected. Since this technique does not rely only on susceptibility effect only, it can be successfully used at standard (1,5T) field strength (see Fig. 2).

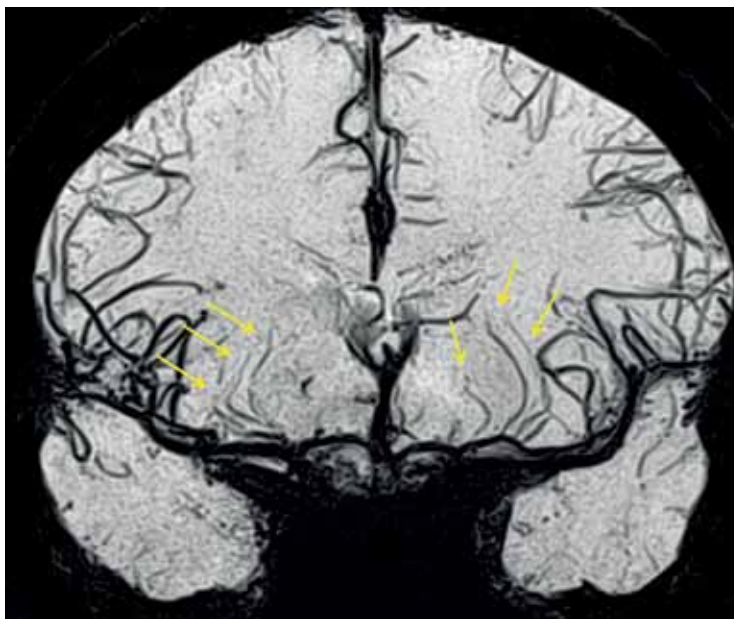
Being a 3D gradient echo technique, FSBB can, like SWI, benefit from the susceptibility effect useful for venous signal visualization. When a long TE value is used (~40 ms) the T2* effect is increased and the venous signal is attenuated which allows a good contrast with the parenchyma. The typical parameters for susceptibility oriented FSBB are: TE: 40 ms, TR: 50 ms, FA: 20, MPG pulse b-factor= 4 s/mm² acquisition matrix size=256 x 224, FOV 205 x 179 mm in one axial 3D slab of 160 slices. The scan resolution is 0.8 x 0.8 x 0.8 mm (reconstructed into 0.4 x 0.4 x 0.4 mm in order to increase apparent resolution) for a scan time of ~6,5 minutes.

A shorter TE value (~20ms) and a lower b-factor would minimize the T2* effect and be more favorable to arterial imaging while minimizing the venous/parenchyma contrast allowing a better artery/veins discrimination (see Fig. 3). The common imaging parameters are TR=29 msec, TE=20 ms, flip angle=20°, MPG pulse b-factor= 2 s/mm² acquisition matrix size=256 x 224, FOV 205x179 mm in one axial 3D slab of 160 slices. The scan resolution was 0.8 x 0.8 x 0.8 mm (reconstructed into 0.4 x 0.4 x 0.4 mm in order to increase apparent resolution) for a scan time of ~6,5 minutes.

Clinical evaluations

T. Kodama and co-authors⁶ from the university of Miyazaki (Japan) compared FSBB to SWI in the visualization of venous malformation (VM), arteriovenous malformation (AVM) and dural arteriovenous fistulas (dAVF) using a 1.5T Vantage ZGV Atlas. They showed that VMs were more clearly visualized on FSBB images than SWI. They found that small VMs could be missed on SWI images. In some cases, portions of draining veins could not be clearly visualized on SWI images. Their findings suggested that direction of vessels in respect to that of the magnetic field affected their visualization on SWI images. Furthermore, they found that drainage veins of AVMs and dAVFs can be hyperintense on SWI images probably because of their arterialization due to the arteriovenous shunt. Even though SWI has flow compensation, feeding arteries sometimes showed signal loss. On FSBB images, all of arteries, niduses, veins, and hemorrhagic lesions appeared as "black" structures. In five patients with AVM or dAVF, prominent venous structures other than drainage veins were clearly noted on FSBB images. These veins seemed to reflect hemodynamic changes such as venous congestion, collateral circulation, and steal phenomenon associated with the AVM and dAVF.

Fig. 3: FSBB image (minIP) clearly showing the LSAs (yellow arrows) at 1.5T field strength in a healthy volunteer



V. Sawlani and co-authors⁷ from Morrision and Singleton hospitals ABM university NHS trust (UK), showed the potential of the FSBB technique on a 1.5T Vantage XGV Atlas system in several cerebral vascular diseases: FSBB was found a useful tool in imaging hemorrhages from trauma, visualizing blood products, venous sinus thrombosis but also in neuro-oncology (see Fig. 4). The microvasculature and hemorrhage of the tumor could be depicted with FSBB. These findings demonstrate the potential of FSBB in tumor grading and in therapy monitoring.

K. Gotoh and co-authors from Kyoto University Graduate School of Medicine, Kyoto (Japan), compared FSBB to TOF in the visualization of the LSAs in 21 healthy subjects (age range 19–44 years)^{8,9}. They found in⁹ a total of 145 LSA branches visualized with FSBB while only 66 branches were visualized with TOF. All the LSAs visualized with TOF were also visualized with FSBB. The images were evaluated

in terms of number, length, and image quality at origins and distal areas of visualized LSA branches. In all evaluated terms, FSBB was significantly better than TOF.

In a very recent study S. Okuchi and co-authors¹⁰ from Kyoto University Graduate School of Medicine, Kyoto (Japan), examined the correlation of LSA imaging findings using FSBB in patients with lacunar infarction compared with age matched controls. They prospectively enrolled fifteen patients (9 men, 6 women, mean age 73 years) with infarction at the basal ganglia and/or its

vicinity, and 12 age-matched control subjects (6 men, 6 women; mean age, 68 years). The authors found that patients with stroke had significantly fewer LSA branches (average 6.3; 95% CI, 5.4–7.1) than controls (8.7; 95% CI, 7.8–9.5) ($P=0.0003$). The total LSA lengths were 117 mm (95% CI, 96–138 mm) for patients with stroke and 162 mm (95% CI, 133–91 mm) for control subjects ($P=0.01$). Only the LSA branch numbers were significantly related to infarction while only hypertension was significantly related to total LSA length.

Discussion and future work

Microvascular brain damage is mainly assessed by imaging the microbleeds (MB) and not by studying the microvasculature itself as this was not possible in-vivo at clinical MR field strength ($\leq 3T$). However, at ultra-high field strength ($\geq 7T$) it has recently be-

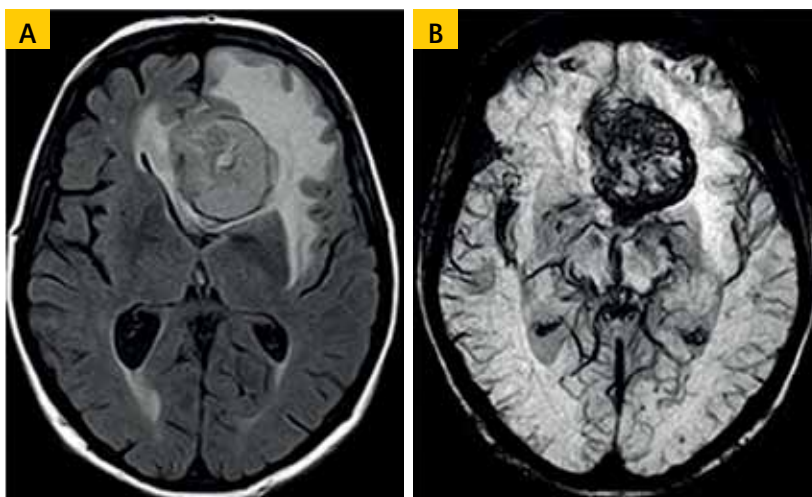


Fig. 4: Primary glioma with hemorrhage. (a) Flair image (b) minIP FSBB image showing complex microvasculature of the tumor (Courtesy of Dr V. Sawlani, Morrision and Singleton hospitals ABM University NHS trust)

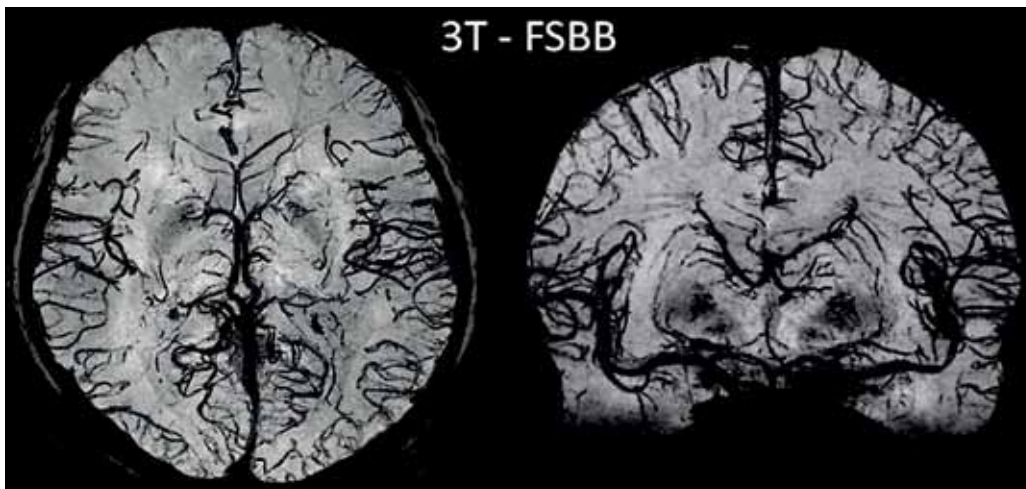


Fig. 5: FSBB images (minIP) acquired on Titan 3T. Note the increased spatial and contrast resolution.

come possible. Therefore, there is a growing interest in studying the microvasculature in small vessel disease and neuro-degenerative disease, during life, at ultra-high field. Unfortunately, ultra-high field MR scanners are still research systems not cleared yet for clinical routine use. Therefore 7T MR systems are not widely available; making it difficult to run large scale (multi-center) clinical studies at present time.

FSBB is a new MR angiography technique that allows the visualization of the cerebral microvasculature at clinical MR field strength (1.5T and 3T). This technique is made available to the wider research community and can benefit all patients having access to standard clinical MR scanners.

The FSBB technique was successfully used at 1.5T to visualize the microvasculature of AVMs, brain tumors, and even lenticulostriate arteries in healthy volunteers and stroke patients.

It is a promising technique and the increased spatial resolution at 3T, down to 0.3 mm or less (see Fig. 5) opens the way to new clinical applications such as small vessel and/or degenerative diseases (vascular dementia, Alzheimer's diseases, Multiple sclerosis, etc.).

Toshiba has recently proposed a hybrid version¹¹, called Hybrid Opposite contrast MRA, combining both TOF and FSBB is a dual echo 3D gradient echo technique for a bright blood visualization of the microvasculature. K. Tsuchiya and co-authors from Kyorin University Faculty of Medicine, Tokyo (Japan), showed in their initial experience a great potential of this technique for the visualization of collateral microvasculature in major trunk steno-occlusive diseases¹².

Toshiba is continuously working on further optimization and innovation in cerebrovascular imaging¹³. Exciting clinical studies are taking place at luminary sites and more clinical evaluations of these innovative techniques are to be expected.

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“Minimize. Visualize”. An Approach to Reaching the Next Level in Patient Care



For the past several years, we at Toshiba have been involved in system development work to further improve accuracy and workflow efficiency in each modality. Progress has been remarkably fast, but our team realized that in order to reach the next level we must place even greater emphasis on patient care.

Our overall global key message is "Improving the quality of life, for patients, for practitioners, for all people." This reflects our policy of taking that extra step in customer care. In the previous issue of VISIONS, my message was that Toshiba is now expanding its focus to include the care of all people. At this time, we are especially focusing on the concept of "Minimize. Visualize." Our goal is to demonstrate that we are a vendor that can continue to develop high-quality imaging technologies to ensure accurate diagnosis and treatment with the lowest possible exposure dose. Let me now introduce some of the advances that have been achieved in each modality.

With regard to MRI, the abstract for the REACT study has been accepted for presentation at ECR 2013. Toshiba Medical Systems Corporation (TMSC) is sponsoring a multi-center trial known as the Renal Artery Contrast-free Trial (REACT). According to Dr. Timothy Albert, who is the leader of the REACT project, Time-SLIP, which is one of Toshiba's non-contrast MR angiography (NC-MRA) techniques, will become a reasonable alternative for assessing renal artery stenosis (RAS) and also for evaluating patients with renal dysfunction who cannot receive contrast agents. I am very proud that we are able to supply our cutting-edge technology in accordance with our new concept, "Minimize, Visualize."

In ultrasound, we have developed Luminance technology. The objective of this technology is, of course, to achieve better image quality, and it is especially useful for visualizing the fetus. This 4D technology provides "Picture Perfect" images, allowing expectant mothers to see the faces of their unborn children more clearly than ever before.

In CT, as you already know, we have successfully incorporated AIDR 3D technology into all of our CT systems. This technology ensures extremely low

doses and clearer images for the benefit of patients. One physician has applied this technology to facial transplant surgery in order to improve the quality of life of patients who have "lost" their faces in terrible accidents. The high spatial resolution of our CT systems makes it possible to visualize the small vascular details that are essential in surgery to restore normal facial movements. A patient who was desperate to undergo facial transplant surgery after suffering with "no face" for 18 months, made a remarkable recovery. This patient's ability to make facial expressions was restored, making it easier for the patient to reintegrate into society. Our technology helped to make this possible.

With regard to X-ray, we introduced our Spot Fluoroscopy technology in the previous issue of this magazine. Spot Fluoroscopy has been widely accepted by both practitioners and patients. It has been calculated that this unique dose reduction technology developed by Toshiba can provide reduction in both scattered dose and area dose dramatically. This is extremely useful for minimizing exposure during atrial fibrillation ablation procedures. Again, this is one of the ultimate expressions of "Minimize, Visualize."

Finally, Toshiba has been selected as an official medical systems partner of Manchester United in England. It is a very competitive process to be named an official partner of this illustrious club, and we are looking forward to Man U's continued success in the future.

I deeply value our relationships with our partners and customers, and it is our customers who will contribute the most to Toshiba's future growth. I am sure that our customers will continue to be the most valuable asset of our company.



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.

Toshiba Medical Systems joins Manchester United

As Toshiba Medical Systems enters a partnership with English Premier League side Manchester United to provide state-of-the-art medical equipment at the club's training ground, team doctor Steve McNally outlines the benefits.

The ground-breaking partnership between Toshiba Medical Systems and Manchester United is set to add a whole new dimension to the treatment the club's medical staff can offer to players. In becoming the club's Official Medical Systems Partner, Toshiba will provide the football club with a CT scanner capable of single rotation volumetric imaging, an MRI scanner and five ultrasound systems including the industry-leading premium Aplio 500.

Club doctor Steve McNally said the installation at the club's Trafford Training Centre in Carrington would provide medical staff with improved diagnostic and screening tools that offer greater degrees of accuracy.

This will allow them not only to monitor healing in injuries and fine-tune rehabilitation processes but also to identify potential injuries and respond to them before they become serious. In addition, it will offer the players more privacy and increased confidentiality when they are injured or ill and avoid the need for them to attend private facilities off-site.

Dr McNally said: 'We've always been fortunate to enjoy good access to imaging facilities in the

locality, but having such equipment on site will be much more convenient and less disruptive in terms of affecting training and rehabilitation programs. The convenience also means that we will have a better opportunity to use imaging as part of our daily routine. It means more privacy, increased confidentiality, and a much better experience for the players as patients.'

He said another benefit of having the equipment available to the club's medical team at Carrington is that medical staff will be able to discover more about just what the different medical imaging modalities can do for them. 'We'll find out which systems are most appropriate at certain times: what is normal, what is abnormal, and what is happening in the evolution of an injury. We can monitor healing in various injuries much more closely.'

The club already operates a comprehensive players screening program, which includes undertaking detailed medical histories and clinical examinations in conjunction with functional tests, physical tests and some medical imaging.

'But we could start to utilise these imaging tools to look in much more detail at the anatomy of players; before they start pre-season training, what it is like after a certain phase of pre-season training, and what happens as they are exposed to the training loads and the game loads throughout the season,' Dr McNally explained.

Toshiba's executive team at the Old Trafford ground, including football stars Giggs, Kagawa and Nani



Photographs by Paul Cooper



Manchester United club doctor Steve McNally believes the biggest long-term benefit from the new equipment will be through the early detection of pathological signs to prevent injury.

'So, we can build a more detailed profile of what happens to the joints, the muscles, the ligaments, the tendons, the heart, the lungs and what effects the training program is having on those tissues and organs.'

Such medical scanning equipment offers the opportunity to build complete medical profiles of players and enhances monitoring of them as they develop and age; from the youngest players at the club who are only eight years old to those in their late 30s such as Ryan Giggs, Paul Scholes and more recently goalkeeper Edwin van der Sar, who was 40 when he stopped playing.

From this, there will also be benefits for Toshiba, which will gain greater insights into sports medicine.

The partnership is the first of its kind in the UK with a football club and Dr McNally believes the Toshiba equipment provided to the club's medical team would help with the accuracy and speed of diagnosis of an injury leading to greater confidence in the treatment plan by both the patient and the treating clinician.

'In combination with our expertise and experience it allows us to inform our coaches and our team manager with a timely and likely prognosis so they can plan for the team and we can plan strategies around the whole injury scenario - not just deal with the individual patient,' he said, adding: 'I think we could also utilise the systems to fine-tune our rehabilitation processes because we can monitor the progress and the evolution of tissue healing alongside the observed functional improvements.'

'That will give us greater confidence in making a certain progression in a rehabilitation program and also what types of exercise and loading we put on a player during that rehabilitation.'

Levels of radiation exposure have always been a consideration with CT scanners but Toshiba CTs are renowned for having very low radiation exposure, allowing its potential use as a screening modality.

Dr McNally said: 'The fact that the Aquilion systems are well-known for having significantly reduced

radiation doses opens up a wider opportunity to use CT as a monitoring tool.'

With MRI, the distinct advantage of the 3-Tesla is speed of imaging and higher resolution, particularly in joint injury.

'The increased detail and the facility to map the cartilage in joints over time will hopefully assist us in terms of the welfare of our players, but also it will allow us to assess the effects of our training programs on their joints,' Dr McNally added. However, he believes the biggest long term benefit from the Toshiba partnership will be in the field of injury prevention by detecting early pathological signs that would trigger



Mark Holmshaw, Toshiba's Vice President Sales and Service Europe, is hopeful to introduce plans for screening and early diagnosis.

a managed response long before they become acute or career-threatening injuries for players.

Manchester United midfielder Ryan Giggs is equally excited about the partnership. 'It's fantastic to have such state-of-the-art equipment at the training ground. It means that having scans or medicals will be much more convenient as everything is there and to hand.'

Giggs, who is 39 and still a regular first team player, joined the club as a schoolboy when the medical team was smaller and access to advanced medical equipment and physiotherapy was limited. With the additions at the Carrington training ground, he added: 'It's no surprise that United are working with Toshiba Medical Systems and will have the latest equipment, such as MRI and other scanners, on site.'



Chikao Kamijima, President & CEO of Toshiba Medical Systems Europe, shakes hands with Sir Alex Ferguson, Manchester United, to confirm the partnership.





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Advanced Techniques in 4D Ultrasound: Fly Thru

E. G. Grant

Ultrasound is a fast, non-invasive imaging technology often used as a first-line diagnostic exam, providing clinicians the ability to diagnose disease quickly and develop treatment plans. Recent advancements in 3D and 4D ultrasound continue to expand clinical applications, and the introduction of Toshiba's Aplio™ 500 ultrasound system offers exciting new capabilities.

Toshiba's Aplio 500 ultrasound system enables clinicians to diagnose disease in new ways, using the most advanced visualization tools in the industry. The system combines advanced imaging capabilities, workflow automation tools and superior ergonomics for more accurate diagnoses and improved departmental efficiency.

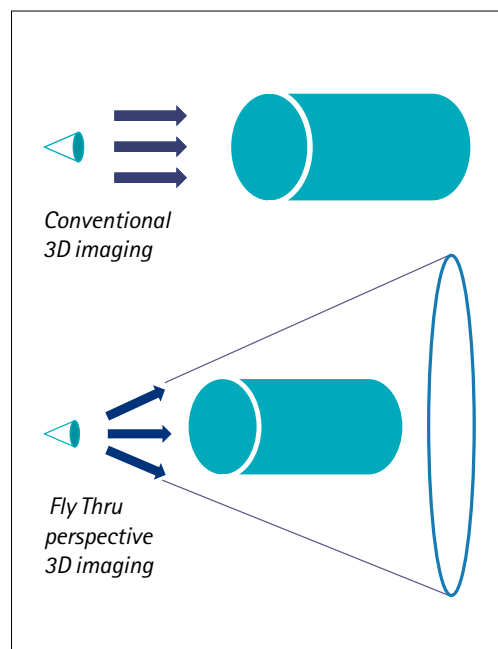
One of these advanced features is Toshiba's Fly Thru technology, an industry first using 4D ultrasound to "fly through" interiors of ducts and vessels for better exploration of lesions and masses and in communication when planning interventional procedures. Fly Thru gives a new perspective of 4D imaging, namely, looking from the inside out. This technology and the images it produces are unlike anything previously found in the ultrasound world. It truly represents a completely unique method of processing ultrasound images and a unique way of looking at structures within the body.

Fly Thru: a new perspective

The engineers who developed the technology refer to this as "perspective imaging" because it produces a different perspective in the way clinicians view various structures. Fly Thru's images virtually travel through a body cavity and are very similar to those produced by CT virtual colonoscopy. Fly Thru enables sonographers and physicians to interrogate anatomy from views never before seen in ultrasound, bringing a whole new dimension to the modality.

Typical 4D imaging uses a parallel projection so one's viewpoint is essentially endless, however this creates difficulties in seeing depth or what is around the anatomy being imaged. Fly Thru is different from traditional 4D imaging, as it uses perspective projection, where the image is displayed exactly as if you were doing an endoscopic procedure.

When using the Aplio 500 in practice, there are various ways to perform Fly Thru. First, the system itself will automatically navigate through the structure,



moving the observer's eye according to the center line of the blood vessel, intestinal tract, mammary duct or any other fluid-filled structure in the body. In this "auto" mode, the system passes through the tubular structure while deciding automatically which branch to follow, for example, through the branches of the portal vein.

The second option is conducting manual Fly Thru navigation, which is useful depending on what is being imaged. In manual mode clinicians direct the arrow, or perspective line of sight, through the structure. For example, in manual navigation when viewing a bifurcating vessel, there is the ability to choose which of the two vessels to interrogate. Likewise, when looking at a polyp in the endometrium, clinicians can view from behind it and investigate another perspective. These two options for both automatic and manual mode provide flexibility in using Fly Thru for various clinical applications.

In addition to automatic and manual visualization modes, Fly Thru's features make it easy to use. The Aplio 500 has rapid reconstruction time and the ability to store the ultrasound volume directly on the unit, allowing images to be viewed after the examination is complete. There is also an over-

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of Medicine

view mode to look at fluid-filled bowel loops or pelvic structures, like the uterus, when they are surrounded by fluid. With overview mode, clinicians can also manipulate the image and view different parts for expanded clinical applications.

Fly Thru images are also acquired like any other normal 3D data set – the Fly Thru mode is pressed, the arrow is pointed in the direction or at the structure being imaged and Fly Thru begins. There is a slight learning curve for the manual navigation mode, but overall it is a very easy technology to use.

Potential clinical applications

The images produced using Fly Thru are extraordinary, and as a new technology, the clinical applications are just beginning to be explored. The first potential clinical application we foresee is imaging of the endometrium. The endometrium is a solid structure, but if it is distended with fluid, as in the case of a saline hysterosonogram, Fly Thru enables a virtual hysteroscopy. This is a new way of viewing polyps, myomata, synechiae or anything that is in the middle of the endometrial canal. Fly Thru is also capable of seeing relatively small fluid-filled structures, for example, dilated ducts in the breast that could assist in diagnosing intraductal papillomas. Another area for potential clinical application is vascular imaging, including venous structures, TIPS, the aorta and endostents.

Other areas with potential Fly Thru applications include obstetrics (OB), for early pregnancy cases and complex fetal anomalies, such as cleft palate and other facial anomalies. Another could be in the imaging of neonatal head, and a completely unique way of viewing hydrocephalus in infants. The GI tract is also a fairly obvious area, with the ability to visualize the common duct or pancreatic duct, the gall bladder or the gut. In the GU tract, hydronephrosis, stones, obstruction, transitional cell carcinomas (TCC) or even bladder lesions have been nicely evaluated with Fly Thru. As we continue to investigate the clinical possibilities, we are excited by the opportunities this technology presents to improve patient diagnoses for many conditions. The following are specific clinical examples demonstrating Fly Thru's potential.

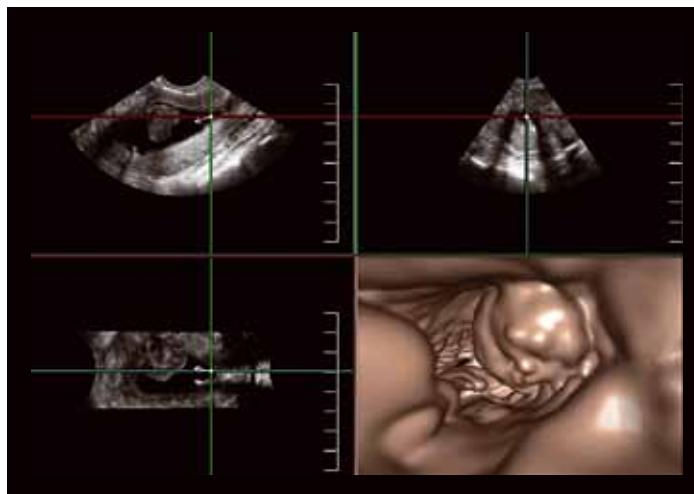


Fig. 1: Large intrauterine polyp

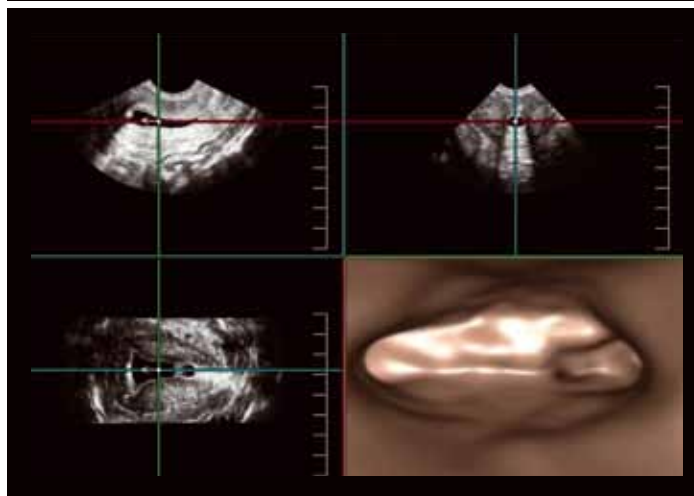


Fig. 2: Normal endometrial canal showing cornua and left fallopian tube (Image courtesy of Bill Smith, CDS, London, UK)

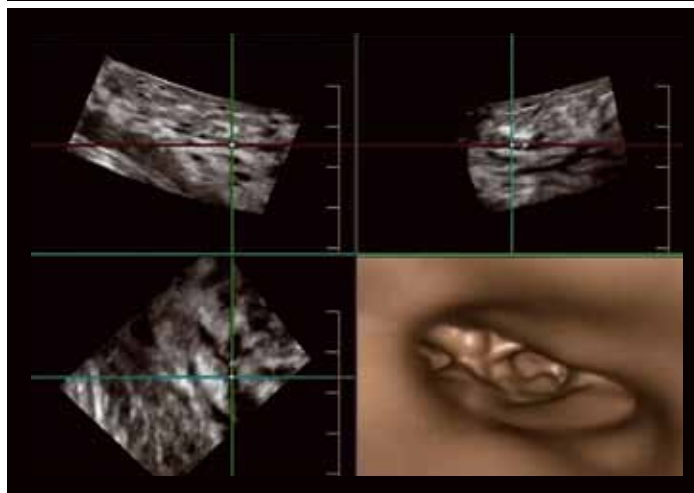


Fig. 3: Fly Thru of the breast demonstrating mild ductal ectasia. (Image courtesy of Dr. T Kurida, Kurida Clinic, Japan)

Virtual hysteroscopy

As stated previously, Fly Thru holds great clinical promise in performing virtual hysteroscopy. Two unique ways to use Fly Thru for virtual hysteroscopy include identifying a polyp and manipulating the image to view it from around the back for more accurate diagnosis (Fig. 1), and to assess the fallopian tubes (Fig. 2), which would be difficult to do with a traditional hysteroscopy.

Virtual ductography

Fly Thru for virtual ductography in the breast can show very small structures only millimeters in

Fig. 4: Partial occlusive thrombosis of the portal vein
(Image courtesy of Dr. Kinkel, Duren Hospital, Germany)



Fig. 5: Middle hepatic vein.

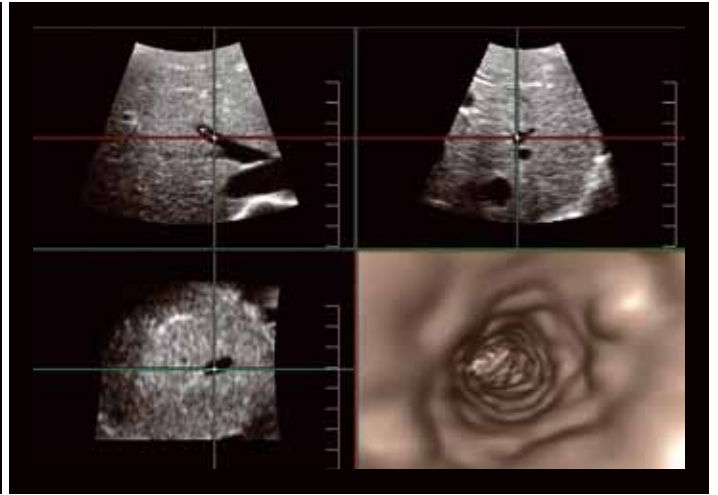


Fig. 6: Tortuous superficial varicose vein (Image courtesy of Dr. J Hata, Kawasaki Medical University, Japan)

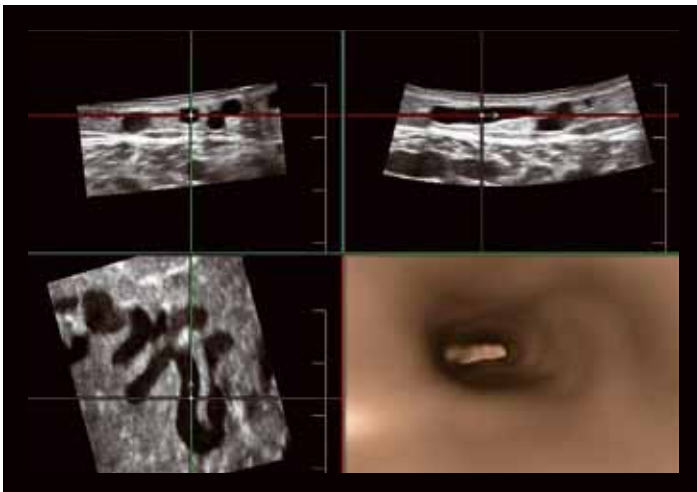


Fig. 7: Patent TIPS stent

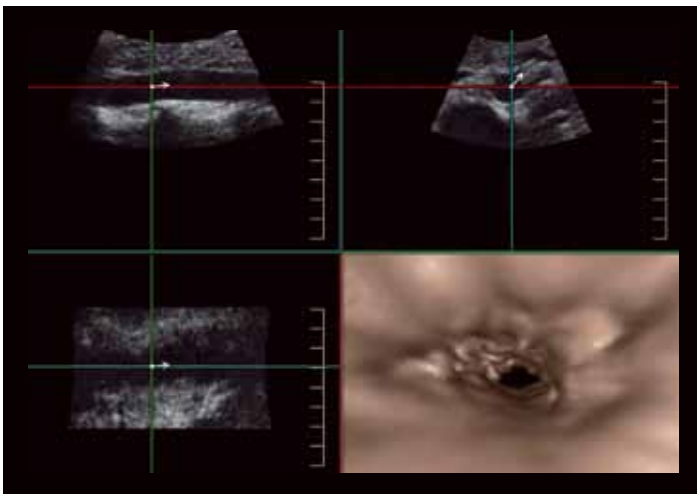
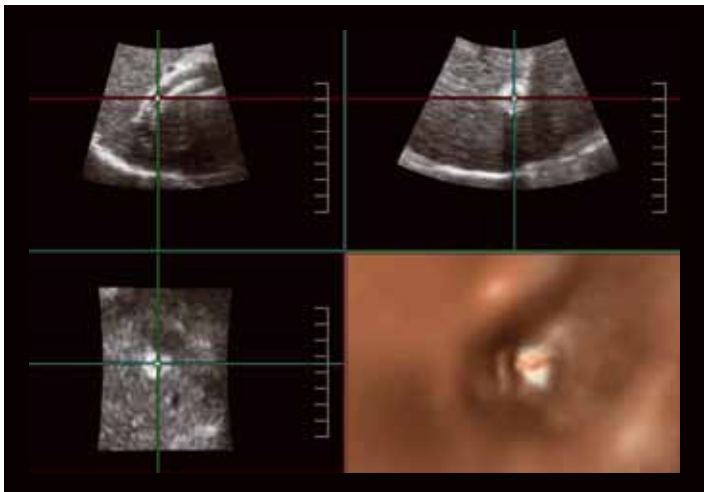


Fig. 8: Normal mid-abdominal aorta

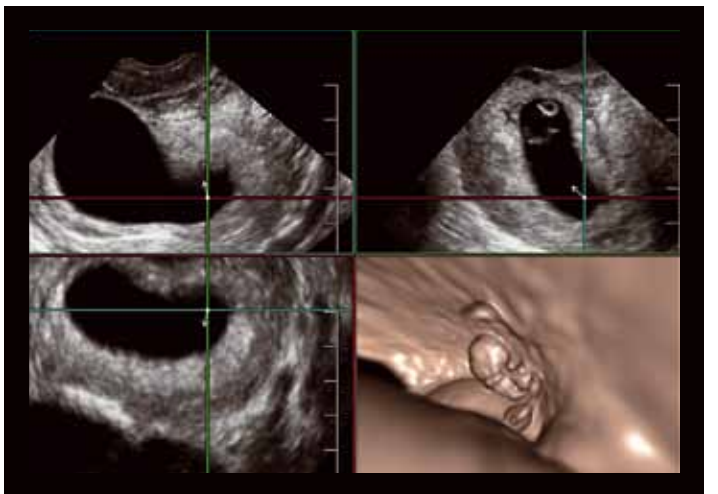


Fig. 9: Eight-week fetus

size and would lend itself well to the evaluation of intraductal papillomas (Fig. 3). No other modality can perform such imaging.

Portal venography

Veins are easily evaluated with Fly Thru. The portal veins are relatively immobile and therefore easy to image. In this example, Fly Thru is able to fly out into the periphery of this portal venous branch.

Portal vein thrombosis

In another clinical example, the mass-like structure in the image actually represents an area of portal vein thrombosis (Fig. 4).

Hepatic veins

The hepatic veins are often fairly large and easily interrogated with Fly Thru. Patients who have undergone a liver transplant may develop stenosis, and this could be a secondary way of identifying areas of stenosis (Fig. 5).

Peripheral veins

Fly Thru can also visualize walls and clots in the peripheral veins, both the deep and superficial (Fig. 6). 4D information provided by Fly Thru is superior to the traditional 2D cross-sectional ultrasound view, and for the first time ever, you can get an image of the true cross section space taken up by a clot.

Transjugular intrahepatic portosystemic shunt (TIPS)

Imaging of TIPS can be very challenging but is potentially made easier with Fly Thru. Most of the stenoses that affect the TIPS occur in the hepatic veins. This area may be difficult to image, and the only way to diagnose stenoses in this area currently is by looking for Doppler abnormalities, such as velocity elevation. In this particular case with Fly Thru (Fig. 7), a real-time image shows the anatomic structure of the TIPS and the ensuing hepatic vein after it, indicating a functioning shunt.

Aorta

When imaging the aorta, there are a couple of technical challenges, most notably motion. Wall motion, if significant, can be problematic when processing an image. With Fly Thru, clinicians can follow the aorta down and view the orifices of the vessels coming off of it, including the mesenteric and renal vessels, and the Iliacs distally. It is a unique application, similar to an IVUS but without performing an interventional procedure. This obviously makes it safer and easier for the patient (Fig. 8).

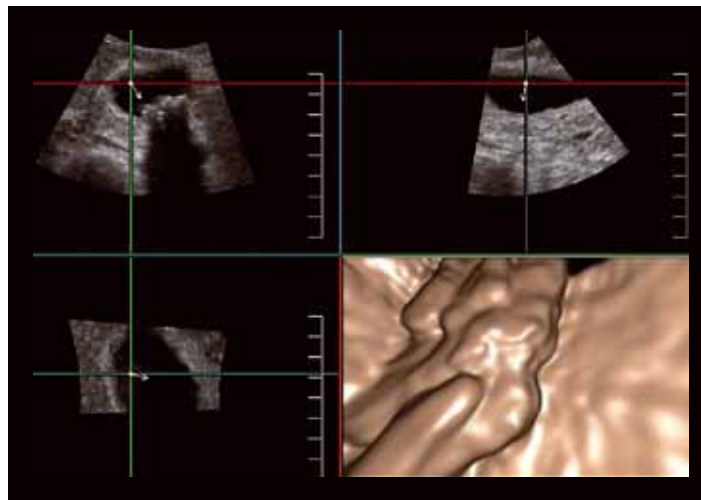


Fig. 10: Multiple small gallstones

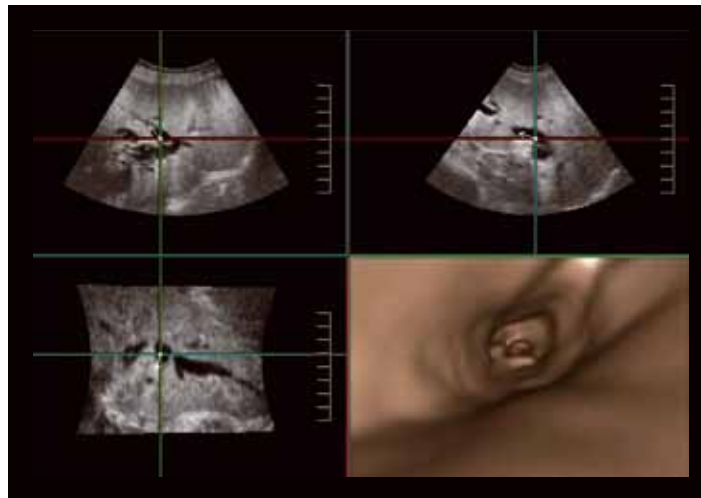


Fig. 11: Intrahepatic biliary ductal dilation (Images courtesy of Dr. J Hata, Kawasaki Medical University, Japan)

Early OB

Fly Thru can also be used for imaging early pregnancies. In this instance, imaging is identical to a 3D sweep, so there is no added interrogation of these patients (Fig. 9).

Gallstones

Fly Thru holds some potential for imaging solid masses that affect the gallbladder wall and provides a new and interesting perspective (Fig. 10).

Bile duct dilation

When imaging bile ducts, Fly Thru has the ability to show ductal dilatation (Fig. 11). Traveling down the duct and into the area around the pancreatic head or ampullary region, a mass-like area can be seen on the horizon which actually represents an ampullary tumor that would be difficult to see with traditional imaging techniques.

Dilated small bowel

When it comes to imaging the bowel, Fly Thru produces images remarkably similar to virtual colonoscopy. In this small-bowel example of a patient with ileus, the valvulae conniventes can be viewed clearly using Fly Thru. Additionally, evaluating polyps or masses of the wall with Fly Thru has the potential to provide improved diagnoses (Fig. 12).

Fig. 12: Small bowel loops in abdominal ascites (Images courtesy of Dr. J Hata, Kawasaki Medical University, Japan)

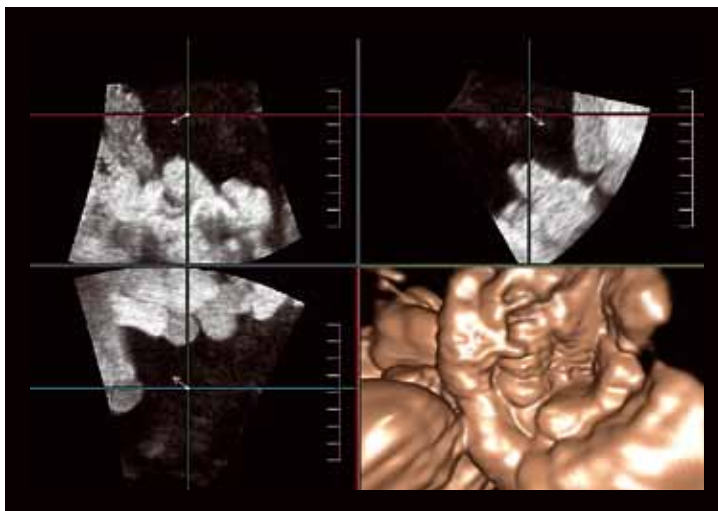


Fig. 13: Dilated distal ureter

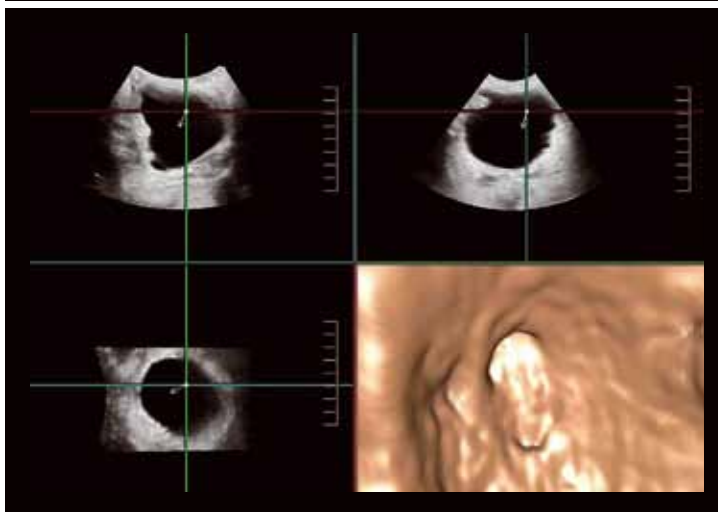
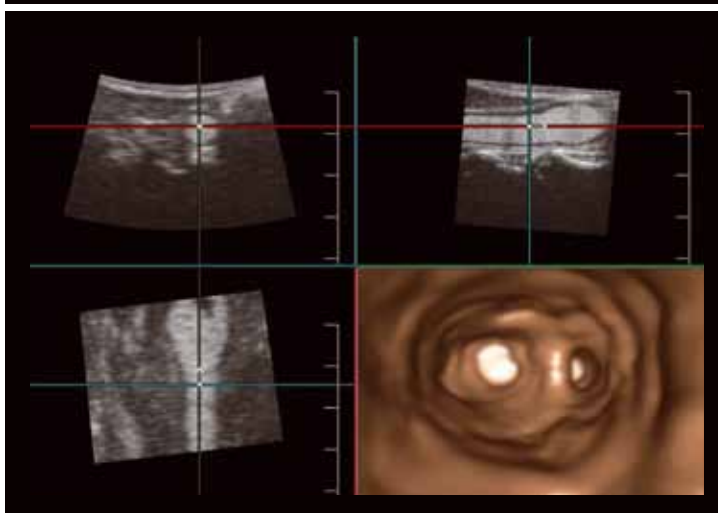


Fig. 14: Contrast enhanced image of the carotid bifurcation (Images courtesy of Dr. J Hata, Kawasaki Medical University, Japan)



Dilated distal ureter

Structures at the distal ureter may also be evaluated using Fly Thru. This directed scan interrogates the ureter moving out of the bladder (Fig. 13), giving us the potential of directly visualizing occlusive kidney stones for the first time.

Future possibilities

As we continue to evaluate the images produced by Fly Thru, there are some additional applications that hold great promise. One of those is using contrast with reversed polarity. Outside the U.S., contrast is often used with ultrasound. While this is off-label use in the U.S., contrast is extremely safe and clinically important. By taking a contrast image, for example, of the carotid artery, Fly Thru is able to reconstruct the lumen of the vessel. In this image (Fig. 14), Fly Thru is able to travel from the common carotid into the internal carotid artery, providing unique images of the bifurcation. It is an interesting application which reverses the normal polarity of the image.

Conclusion

Fly Thru has the ability to yield more than just appealing images and could potentially improve the diagnoses of many diseases with ultrasound. The pictures produced are incredible and previously unseen in ultrasound, providing a unique form of imaging adaptation of 4D ultrasound. In addition, this provides a potentially powerful tool for

communicating with a surgeon, an interventional specialist or the patient. For clinicians, this exciting new technology offers an untapped potential of clinical applications to improve patient care with ultrasound.

Virtual Navigation – A New Modality in Perioperative Brain Tumor Imaging

M. Filip¹, P. Linzer¹, D. Skoloudik²

Summary

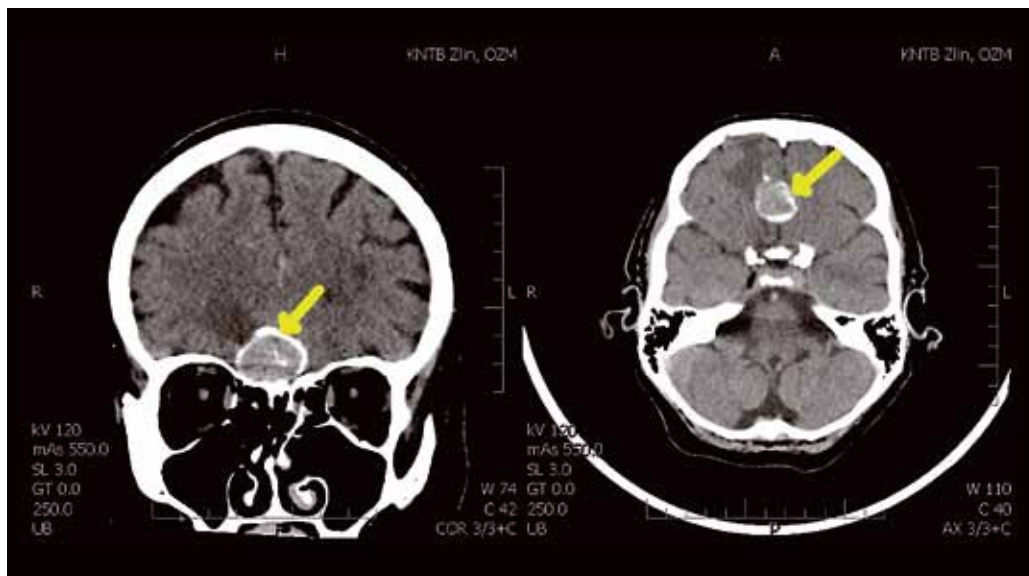
Ultrasound (US) is gradually gaining in importance in neurosurgery alongside perioperative CT/MRI as a useful tool for imaging brain lesions pre- and peri-operatively. The basic examination currently involves two-dimensional ultrasound imaging (B-mode). To improve and refine orientation within the operating field, 3D ultrasound imaging using computer-aided reconstruction of a series of consecutive 2D US sections similar to CT/MRI was developed in the late 1980s. Although the 3D ultrasound model significantly improved control over the procedure itself, perioperative MRI remained the most precise method, especially when small, deeply located brain lesions (cavernomas, small gliomas and similar lesions) were concerned. Norwegian neurosurgeons developed

SonoWand, a separate navigation system as an alternative to perioperative MRI, making it possible to fuse the image by linking the findings of preoperative navigation (CT/MRI) with those obtained using perioperative ultrasound. Such a fusion of images seems to successfully combine the advantages of both modalities into a single image and for most patients represents a perfect alternative to perioperative MRI. Smart Fusion, the virtual navigation developed by Toshiba is the next step to further improve image fusion. Here, a separate navigation system is integrated directly into the ultrasound system (Toshiba Aplio 500). Before the intervention, a study of pre-operative CT/ MRI investigations is downloaded in DICOM 3 format; the ultrasound is connected to an electro-magnetic field transmitter and the ul-

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Fig. 1: Preoperative contrast CT scan (olfactory groove meningioma)



trasound probe is connected to a sensor that registers position within the electromagnetic field. Once reference points have been registered, the system can simultaneously provide real-time ultrasound images and the corresponding CT/MRI images from the downloaded dataset. Thus the probe can be used for preoperative examination and planning and for perioperative imaging with or without fusing both modalities. Our Department of Neurosurgery, KNTB Zlín, in cooperation with the Department of Neurosurgery, UH Ostrava, has been testing this method of perioperative imaging in brain tumor resections since June 2011. The first tests were conducted with a different vendor's system. We started using the Toshiba technology in May 2012.

more recently accompanied by changes in behavior (depression, slowed mental reactions). She was examined by a neurologist and based on a CT scan with contrast medium she was diagnosed with anterior cranial fossa meningioma (olfactory groove) 2 x 2 x 3 cm in size, with peri-focal edema of the adjacent cerebral tissue (Fig. 1). An implanted cardiac pacemaker prohibited the use of MRI. In view of the deep location and size of the tumor, we decided to perform a right-sided fronto-temporal craniotomy and used the Toshiba fusion imaging solution, both to improve the precision of the access trajectory and to control the degree of resection radicality in relation to the surrounding cerebral tissue.

Case history

Resection of anterior cranial fossa meningioma (Fig. 1)

The patient presented with headaches which she said she had been experiencing for several years,

Fig. 3: Fusion of CT/ultrasound images during perioperative trajectory planning in the coronal and horizontal planes



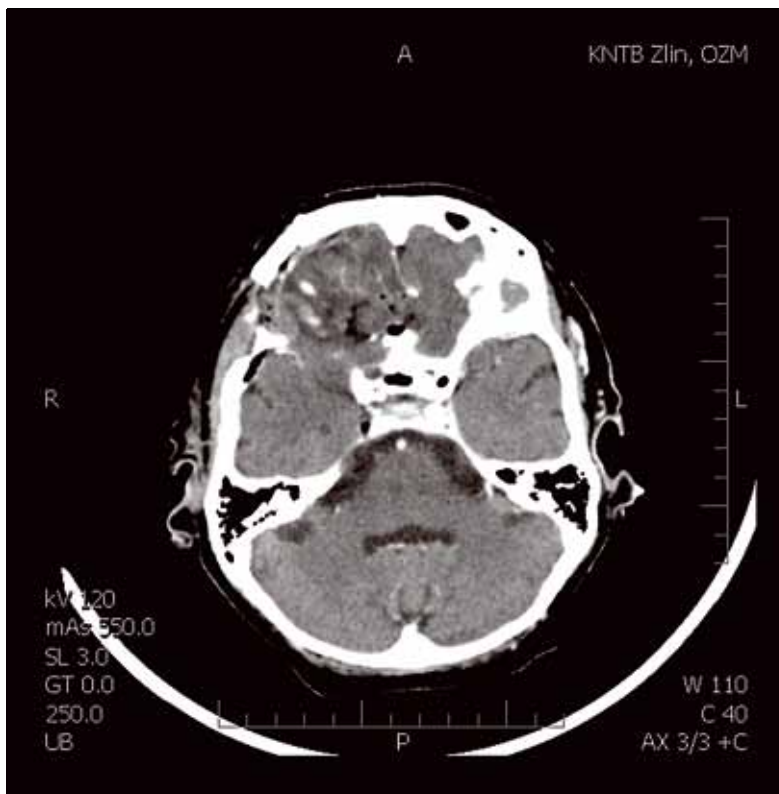


Fig. 4: Follow-up contrast CT scan 24 h after surgery (radical resection with perifocal edema)

We then conducted a radical resection of the expansion using microscopic surgical techniques under perioperative ultrasound control. The tumor was removed in total without any damage to the surrounding brain tissue as demonstrated by subsequent postoperative CT scans and the uncomplicated postoperative course (Fig. 4).

Discussion

Image fusion during brain tissue surgery obtained using virtual navigation technology can link the characteristics of preoperative navigation and perioperative ultrasound imaging within a single system. This can significantly facilitate planning of access trajectories at the outset of surgery as well as orientation in the operative field and its surroundings during the procedure itself. Based on our first experience with the Toshiba system, we are in the position to describe the advantages and disadvantages of this technology compared to other imaging techniques. In our view, the major advantage is better orientation due to the high-quality imaging during navigation and the procedure itself obtained using the ultrasound probe and the position detector in all modalities compared to the separate use of navigation and perioperative ultrasound. A further advantage is the fact that this set-up takes less space in the operating theatre as the downloaded preoperative results can be directly transferred into the ultrasound system and the electromagnetic field source is smaller than systems that use optical navigation. Moreover, the ultrasound and the navigation system can be used independently for other types of surgery (e.g. navigation of targeted biopsy, possible use of the ultrasound equipment itself outside of the operating theatre for standard ultrasound diagnostics). Last but not least, the costs of the entire Smart Fusion (Toshiba sonograph + navigation) system are comparable to the costs of a high-performance single-purpose ultrasound system.

Prior to the procedure, data from the CT scan in the corresponding format were transferred to the ultrasound system. Once the patient was under general anesthesia and her head was fixed in a three-point clamp, we placed the electromagnetic field generator at a distance of approx. 60 cm from the planned craniotomy site. We attached a position sensor on a micro-convex ultrasound probe (3–6 MHz) and connected all the sections using cables (ultrasound – transmitter – sensor) (Fig. 2). After routine preoperative preparation, we performed a standard frontotemporal craniotomy on the right side. Having lifted off the bone flap, we obtained a fusion of the CT and 2D ultrasound images in two steps. We first registered the perpendicular/transverse position of the sensor in relation to the patient's body axis. We then correlated the CT/US images according to the reference points that were well visualized in both types of imaging. In our patient, the reference structures included the falx cerebri, the 3rd ventricle and the crista galli. Having confirmed the correlation of the incision, the system then self-centered both images in the remaining two X and Y axes (left-right and ventro-dorsal). Using the resulting fusion images, we navigated an optimal access trajectory below the frontal lobe towards the expansion in the mid-section of the olfactory groove (Fig. 3). Movement registered by the probe in the electromagnetic field resulted in the system providing continuous CT/US sections in all three planes.

Complementary Mamma Diagnostics to Characterize Focal Breast Lesions

T. Fischer, A. Thomas, U. Bick

Introduction

Contemporary breast cancer diagnosis is a team effort requiring multidisciplinary assessment of the patient and the application of multimodality diagnostic techniques to optimize detection and characterization of breast tumors. Ultrasound used in this context requires highly specialized systems with optimized presets enhancing B-mode image quality and providing functional tumor analysis such as tissue elasticity and microcalcification visualization. Focused "second look" sonography supports diagnostic work-up by correlating previously undetected lesions using MRI and ultrasound and requires ultrasound systems with exact presets and premium technology.

Elastography

Elasticity is an important feature of tissue which can change corresponding to age and pathophysiological processes. An established criterion in the assessment of breast lesions relates to the clinical evaluation of elasticity by palpation. Ultrasound elastography is an imaging procedure which can describe the stiffness of a suspect region. Problematic cases in breast cancer diagnosis relate to lesions in the BI-RADS score categories 3 and 4, and small lesions with lipomatous involution. If elastography as a supplementary procedure can provide information about the lesion

stiffness it may allow a better, more unambiguous classification of lesions into BI-RADS categories 3 and 4. Several studies confirm this additional tissue elasticity information enhances the specificity of the ultrasound evaluation allowing differentiation of malignant breast lesions. Subsequently histological confirmation of such lesions may no longer be necessary, sparing the patient unnecessary biopsies.

Changes in elasticity can be described quantitatively. The elasticity parameter can be determined as a strain ratio between normal and suspect breast tissue, the so-called fat-lesion-ratio (FLR), facilitating differentiation of lesions and further standardization of the method.

Microcalcifications

Microcalcifications are important incidental findings in asymptomatic patients with pre-cancerous pathologies or existing breast cancer. In approximately 40% of the patients with a non-palpable tumor, microcalcifications are the first indication of malignancy detectable in mammography. Mammography remains the gold standard for detection, characterization and localization of microcalcifications in the breast and in breast biopsy samples. While the role of ultrasound in the detection of microcalcifications is still being debated, the combination of sonography and mammography to detect microcalcifications increases both the specificity and positive predictive value of mammography. This suggests that sonography should be used in a highly targeted manner to localize microcalcifications in combination with mammography, rather than as a screening tool in isolation.

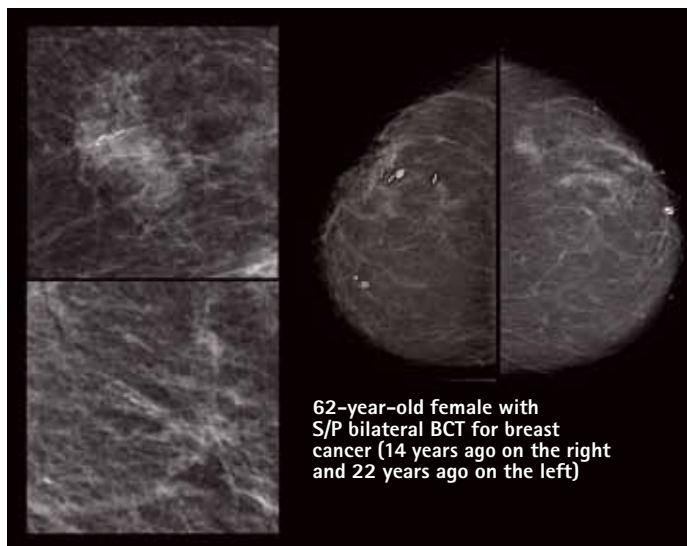


Fig. 1a: Digital mammography of 62-year-old patient with surgical clips and macrocalcifications after breast-conserving therapy. Enlargement shows a microcalcification cluster on the left rim.

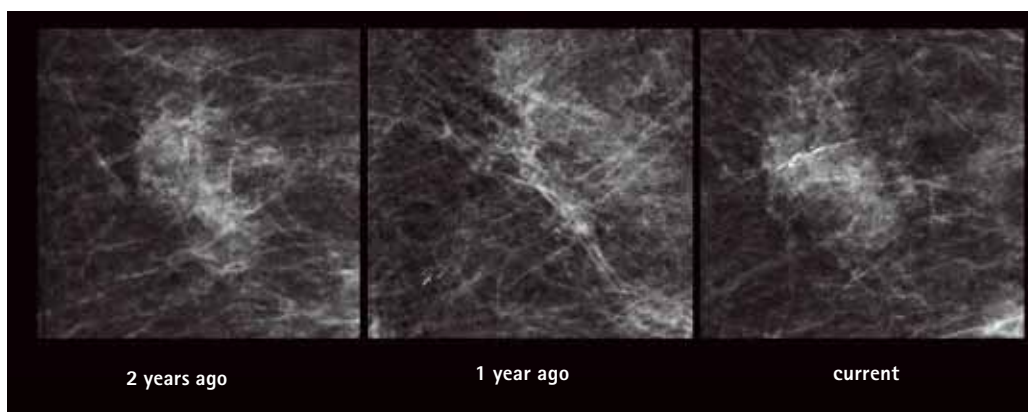


Fig. 1b: The cluster has clearly progressed within two years.

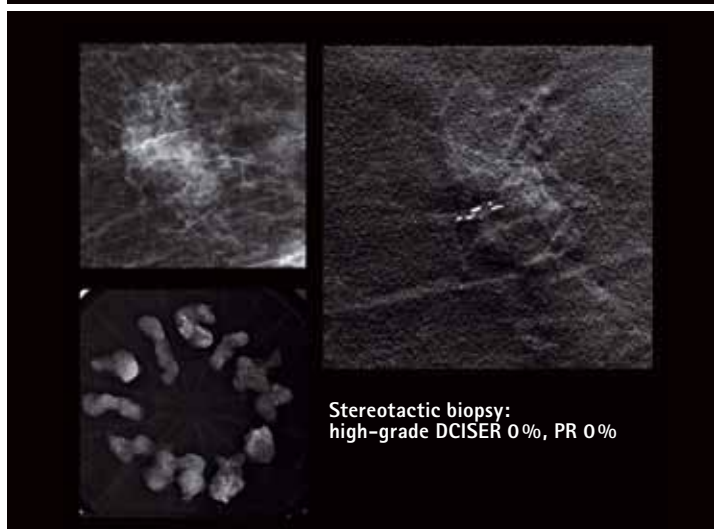


Fig. 1c: Tissue sample radiography after stereotactic biopsy and surgery planning with digital mammography

Moreover, sonography is capable of detecting invasive components of a tumor in case of existing microcalcifications, which means that the transition from DCIS to invasive carcinoma can be diagnosed to avoid underestimation of subsequent biopsy findings. Additionally ultrasound-guided biopsies provide a clinically important tool to assess microcalcifications detected in sonography and mammography with the added advantages that they are comparatively inexpensive, do not involve radiation exposure and are more comfortable for the patient than the more complex and less well tolerated stereotactic biopsies.

Image quality

As early as 1988, Kasumi showed that sonography was capable of detecting microcalcifications of 110 μm . Ultrasound image quality has significantly advanced ever since. The introduction of high-resolution ultrasound performed with high frequency transducers, modern technologies to reduce noise such as Tissue Harmonic Imaging (THI), spatial and frequency compounding and volume imaging of carcinoma in the frontal plane, have boosted diagnostic performance significantly. Nevertheless, the detection of microcalcifications with ultrasound remains a challenge, particularly in hyperechoic, fibroglandular breast tissue with many hyperechoic areas. Visibility and detectability of hyperechoic microcalcifications are enhanced on a hypo-

echoic background. With this in mind, MicroPure was developed as a novel ultrasound technique to improve the visibility of microcalcifications. Combined with advanced signal processing options such as Precision Imaging, speckle noise can be greatly reduced and microcalcifications are highlighted, analogous to airplane radar systems.

Case study

A 62-year-old patient presented at a Breast Unit certified since 2003 by the German Cancer Society and the German Senology Society. The patient participated in a special senology program for intensified early detection and follow-up of high-

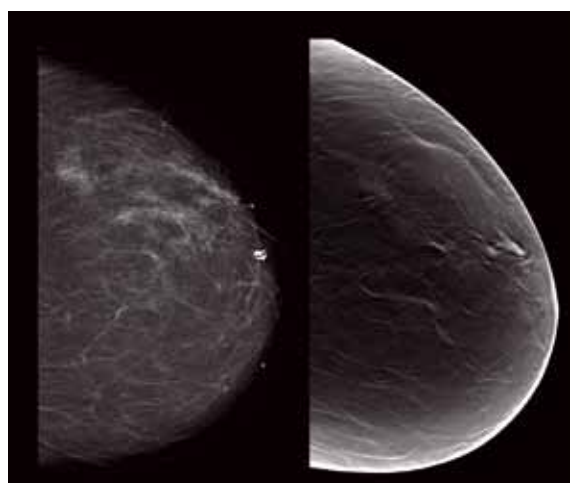
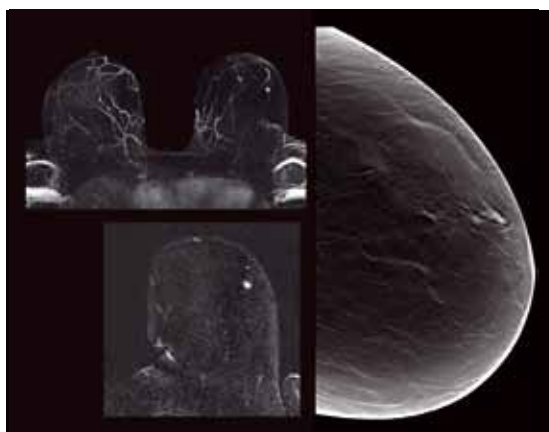


Fig. 1d: Mammography (left) and tomosynthesis; only tomosynthesis allows clear delineation of the finding (right, arrow).

Tab. 1: Simultaneous image analysis with BI-RADS and Tsukuba score

Category	ACR BI-RADS	Tsukuba Score
0	Incomplete	
1	Negative	Strain in the entire area (lesion and surrounding area)
2	Benign finding(s)	Strain in the lesion
3	Probably benign	Strain only in the peripheral areas
4	Suspicious abnormality	No strain in the lesion
5	Highly suggestive of malignancy	No strain in the entire area (lesion and surrounding area)
6	Known biopsy-proven malignancy	

Fig. 2: MIP and subtraction after contrast agent application (left) show early and strong enhancement of the small lesion on the left side; in addition, the broad vessel in the surrounding tissue is visible in correlation to power Doppler (see Fig. 5); tomosynthesis shows the morphology of the lesion (right) particularly well



show cluster-shaped microcalcifications (digital mammography in two planes, Fig. 1a) with serial studies confirming enlargement of the microcalcifications and hence their progress (Fig. 1b). Stereotactic vacuum aspiration biopsy confirmed high-grade DCIS (Fig. 1c).

Since this high-risk patient was participating in a program for intensified early detection she underwent additional MRI and tomosynthesis (Fig. 1d). Here both modalities showed a lesion of 5 mm suspicious for malignancy. Following these MRI investigations and findings a "second-look" sonogram was scheduled (Fig. 2).

This targeted sonographic re-evaluation utilized a premium ultrasound system, the Aplio 500 and a linear broadband transducer PLT-805AT at 9 MHz (both Toshiba Medical Systems, Otawara, Japan). To best delineate the advanced lipomatous involution of the breast, parameters which optimize the B-mode image to enhance lateral and axial resolution and reduce speckle noise were integrated in the standardized preset (spatial and frequency compounding as well as Differential Tissue Harmonic Imaging). Target-

risk patients with BRCA 2 mutation. Patient history revealed breast-conserving surgery 22 years ago (left) and 14 years ago (right) subsequent to the diagnosis of invasive ductal mamma carcinoma. Currently the patient reported left sided pain, however no lesion was palpable. Sonography and mammography were performed with neither detecting a tumor. Mammography however did

Fig. 3: 4 mm hypoechoic lesion (left) and microcalcifications in the rims (right).

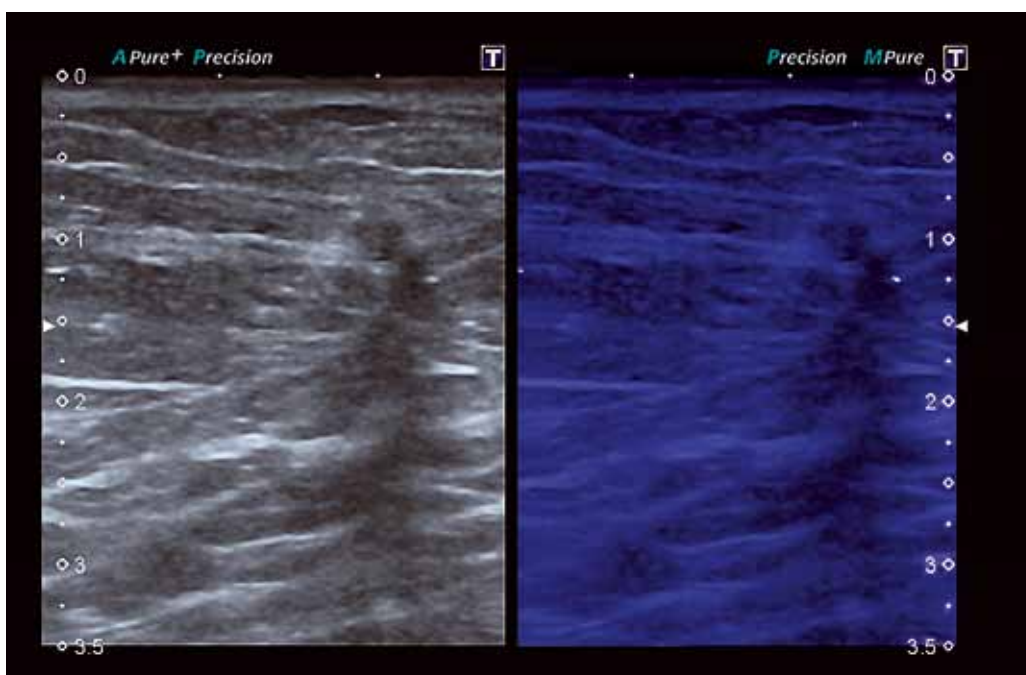


Fig. 4a: Tissue Doppler Imaging (TDI) with defect of the suspected tumor area, vibration elastography, a pressure-independent real-time procedure

ed sonography revealed a hypoechoic architectural distortion of 4 x 3 mm with unilateral shadowing and a disrupted Cooper's ligament. In addition, MicroPure was able to visualize an adjacent microcalcification (Fig. 3). Border delineation of the lesion was not clearly assessable.

Due to the small size of the lesion and its categorization as BI-RADS 4 Tissue Doppler Imaging (TDI) and elastography including FLR determination were performed. Despite its small size the lesion showed low elasticity (blue = stiff, non-elastic tissue) which corresponds to an elastography or Tsukuba score of 4 (Tab. 1). Vibro-elastography performed with TDI showed a color defect in the tumor. The FLR of the lesion compared to surrounding tissue was 3.17 and thus higher than the cut-off value of 2.2 (Fig. 4a-c).

In a final step vascularization of the lesion was documented using Power Doppler at low PRF and imaging the frontal plane using a 14 MHz high-resolution volume transducer (Fig. 5 and 6).

Imaging the lateral plane (Fig. 6) allows confirmation of major malignancy criteria (retraction and spiculation) even in small lesions. Vertical orientation, surroundings (disrupted Cooper's ligaments) and strong acoustic shadowing are further criteria that allow categorization of small lesions with optimized ultrasound technology into BI-RADS category 5. The most important criteria are summarized in Table 2.

Histological assessment was performed with high-speed core biopsy (Bard MAGNUM Biopsy System, Bard, Tempe, USA), using a 14 g x 16 cm biopsy needle (Fig. 7). Two biopsies were performed and exact needle position was documented. In

Fig. 4c: FLR of 3.17 is slightly above the cut-off value. In previous studies findings above a cut-off value of 2.2 were classified as malignant with high sensitivity and specificity.

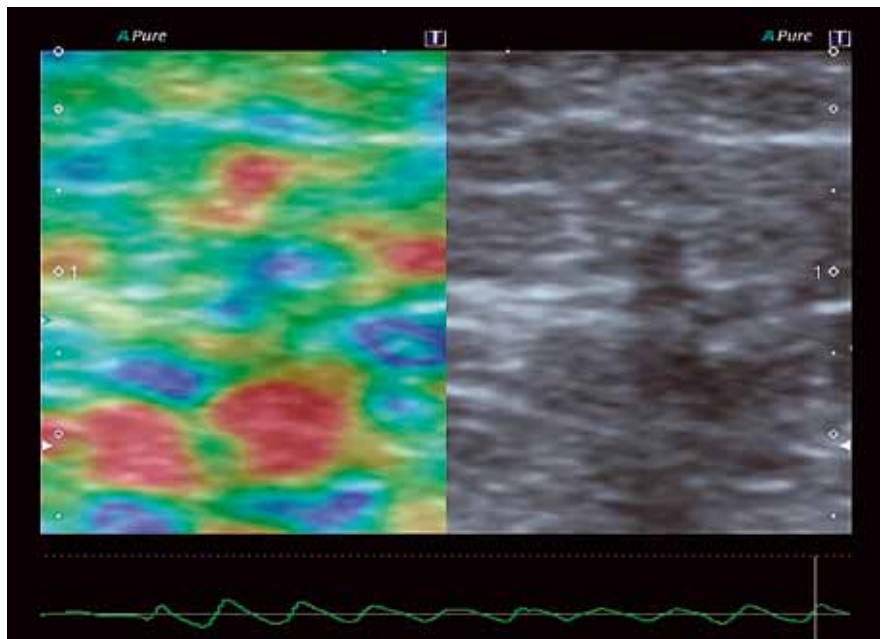
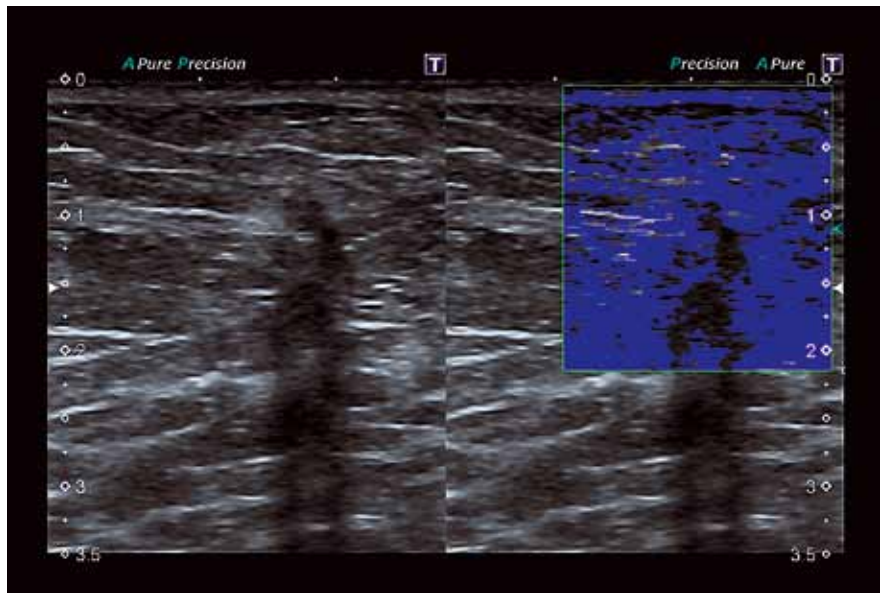


Fig. 4b: Elastography (left) and parallel B-mode image (right): low strain on the lesion.

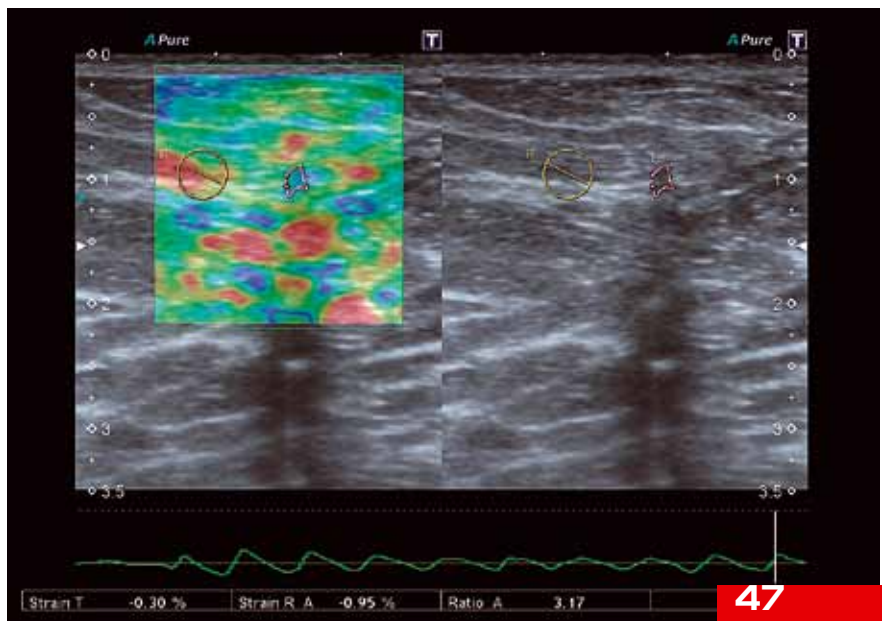


Fig. 5: Power Doppler shows strong vessels adjacent to the tumor, the vascularization index at 5.7% of the entire area is rather low. Nevertheless the branching-off of the strong vessel is typical for a tumor feeder vessel.

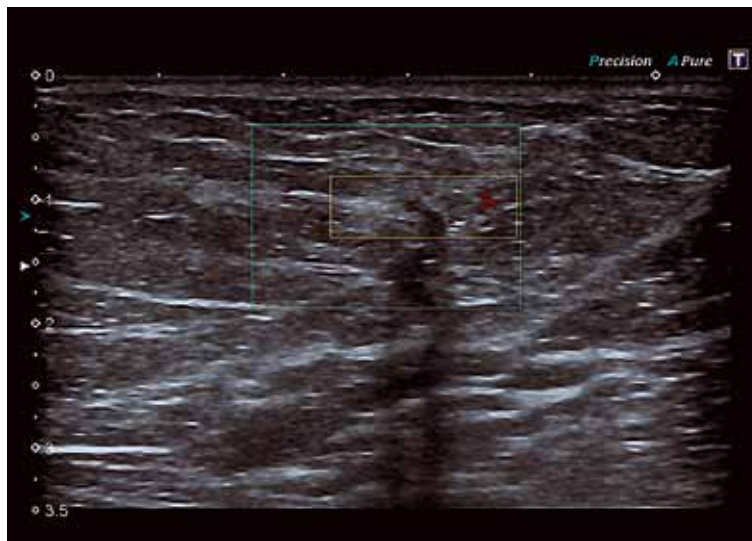


Fig. 6: Volume sonography and 3D visualization of the lesion. In the frontal plane note irregular delineation and retraction which are both malignancy criteria.

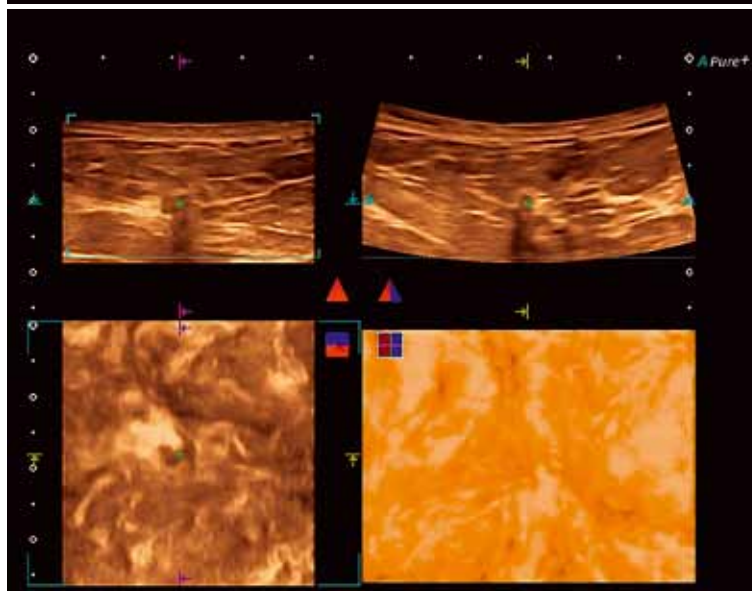
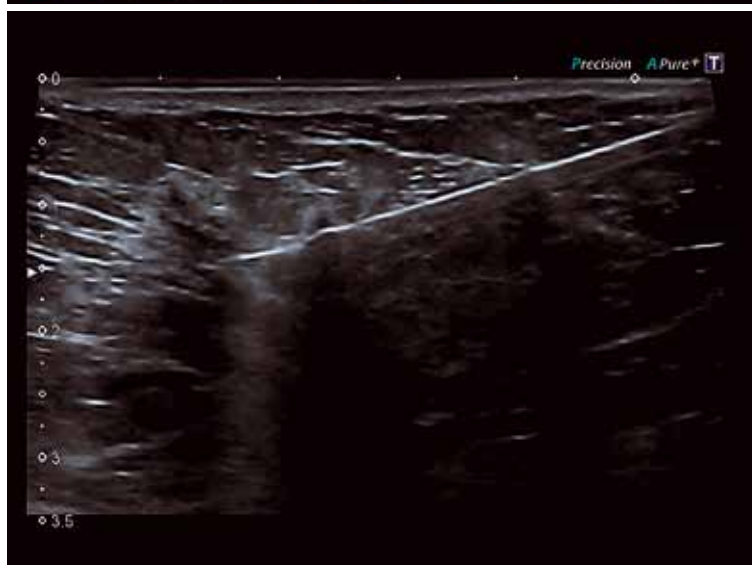


Fig. 7: Histological confirmation with US-guided core biopsy



addition to standard HE staining immune histological investigations were performed and the hormone receptor status was linked (Fig. 8a and 8b). An invasive ductal mamma carcinoma was diagnosed (G2, ER 100%, PR 0%, HER 2 negative, MIB-1 10%).

Discussion

Early elastography studies were difficult and complex making the technology unsuitable for routine clinical use. State of the art clinical systems now integrate high resolution imaging and elastography allowing easy application into routine patient care. Studies report increased diagnostic specificity when breast ultrasound combines elastography and B-mode image information. Comparison and correlation of the Tsukuba score for elastography, the BI-RADS criteria for mammography and B-mode image could potentially contribute to improved standardization of sonoelastography examinations, as evidenced by the present case study.

In this case standardized investigation in the context of second-look ultrasonography allowed definite categorization of the lesion as neoplastic with histological confirmation of the finding. Due to its small size the lesion had not been detected in either initial routine sonography or mammography. This example underlines the diagnostic value of MRI for early detection of breast cancer. However, in order to further evaluate and classify suspicious MRI findings a premium ultrasound system with state of the art applications for lesion characterization is required. In the present case,

Criteria	2D imaging		3D imaging, frontal plane	
	malignant	benign	malignant	benign
Shape	irregular	oval, round		
Orientation	vertical	parallel		
Echogenicity	hypoechoic towards fat	iso-, hyperechoic		
Echo texture	complex	homogeneous		
Microcalcifications (white spots)	present	absent		
Margin	hyperechoic halo	thin capsule		
Shadowing	shadow	enhancement		
Surrounding tissue	architectural distortion	compression		
Margins	irregular, spiculated	even, lobulated (<5)	irregular, spiculated	even, lobulated (<5)
Delineation	poor	good	poor	good
Retraction			present	absent

Tab. 2: Especially criteria such as the presence of microcalcifications, surrounding tissue structure and tissue retractions (in bold) can be well visualized with modern sonography technology; retractions are specific to 3D ultrasound.

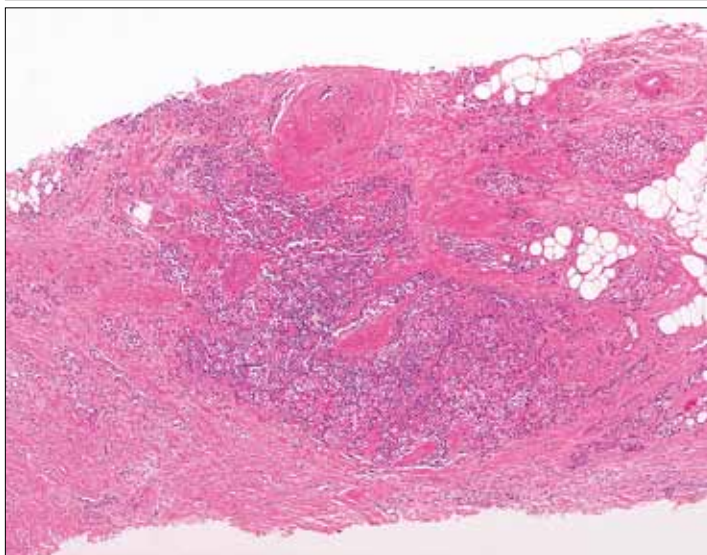
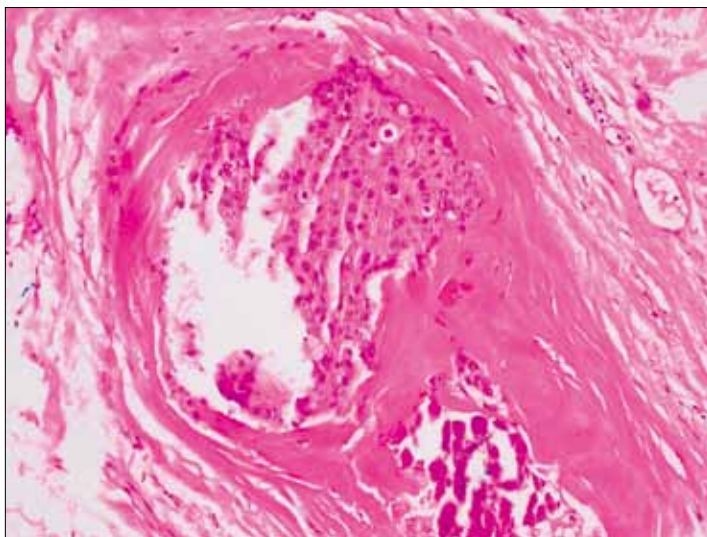
following extensive consultation and confirmation of DCIS and invasive carcinoma, the patient decided to undergo left-side mastectomy.

While the high-quality B-mode image was the foundation of the sonographic malignancy assessment in breast, several approaches to tumor characterization were applied: Tissue Doppler Imaging (TDI), elastography with FLR determination, visualization of microcalcifications with MicroPure and volume sonography (retractions visible in the C-plane).

One of the most impressive results was the good correlation of ultrasound, tomosynthesis and dynamic MRI despite the fact that the lesion had not been clearly visible in the initial sonography and mammography. Microcalcifications on the other hand were clearly detected and confirmed in mammography.

Aware of the MRI results, final histological confirmation of the breast cancer was based on enhanced B-mode image technology and ultrasound-guided core biopsy.

Fig. 8a: Result of the vacuum aspiration biopsy: DCIS with microcalcifications (arrow), HE stain, 20x



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Fig. 8b: Result of the US-guided core biopsy: invasive ductal mamma carcinoma G2, ER 100%, PR 0%, HER 2 negative, MIB-1 10%, HE stain, 10x

Advances in Ultrasound: Smart Fusion Technology

N. Azar

Today's leading radiology departments rely on fusion imaging for better clinical accuracy. A new fusion technology, Smart Fusion on Toshiba's flagship Aplio 500 ultrasound system, merges previously acquired diagnostic images with real-time ultrasound to provide safer, faster exams with better diagnostic accuracy.

What is Smart Fusion?

Smart Fusion presents volume-to-volume fusion of two different imaging modalities, using previously acquired images with real-time ultrasound. CT is the most commonly used modality for ultrasound fusion with the other option being MRI.

Toshiba's Smart Fusion is easier to use than previous fusion technologies. Originally, fusion required scanning the patient with CT, then performing fusion imaging while the patient was in the exact same position with ultrasound. This cumbersome method results in additional radiation exposure to the patient and occasionally additional contrast, along with the high costs of acquiring an ultrasound system and CT system together. But with Smart Fusion, previously

acquired CT and MRI images can be imported onto the Aplio 500 ultrasound system. Smart Fusion has an easy-to-use, intuitive two-step user setup and is fully integrated on the ultrasound system.

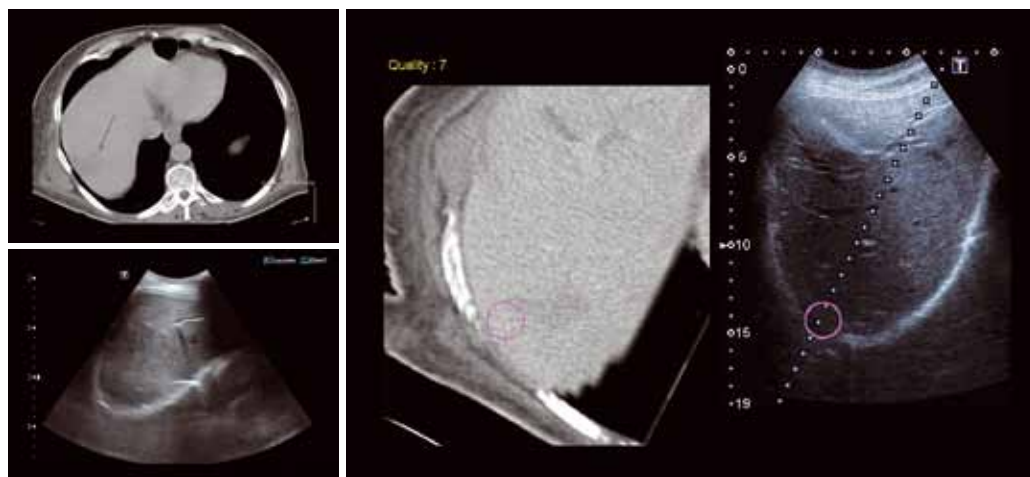
Clinical applications for Smart Fusion

In general, the clinical applications for Smart Fusion include three major components: diagnostic, interventional and therapeutic.

Diagnostic applications

Ultrasound is extremely helpful in characterizing focal lesions as solid and/or cystic and plays an extremely critical role for patients who cannot receive intravenous contrast. MRI used to be the standard clinical practice for evaluating patients with impaired renal function, but the risk of nephrogenic systemic fibrosis (NSF) has limited the use of MRI for these patients and expanded the use of ultrasound. Ultrasound is also a less expensive modality with no radiation exposure. However, one disadvantage of ultrasound is operator dependency. Operator skill is vital

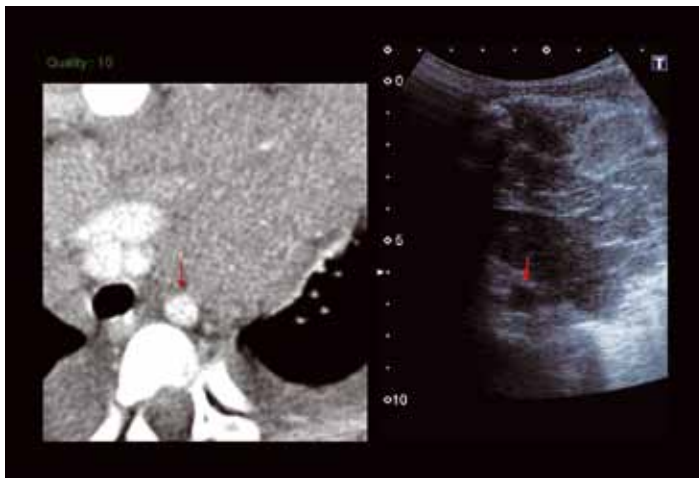
Figs. 1: 40-year-old male with a possible liver lesion as marked by the black arrow. The lesion was identified on the CT image (Fig. 1a), but it was unclear whether it was a true lesion. Follow-up ultrasound showed no sonographic evidence of the lesion that appeared on CT (Fig. 1b). Another follow-up ultrasound using Smart Fusion showed sonographic evidence of the lesion that appeared on CT. A biopsy confirmed the suspect lesion to be fatty changes. This case illustrates the dramatic value of Smart Fusion to more accurately visualize questionable lesions (Fig. 1c).



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Figs. 2: A 9-year-old male presented with a large mediastinal mass seen on a prior chest CT (Fig. 2a). The mass appeared to be encasing critical areas of the chest like the heart. By using Smart Fusion in the operating room, while the child was under anesthesia, the critical structures including the aortic arch were easily identified on the fused images. Additional fused images clearly visualize the descending thoracic aorta (marked by the red arrow in the image) (Fig. 2b) which can be difficult to visualize with ultrasound.



Smart Fusion can also help track a lesion's change in size during follow-up exams. These small changes in size are usually difficult to notice with regular ultrasound. Smart Fusion will enable the operator to evaluate any questionable lesions in real-time to obtain more accurate diagnostic information.

in obtaining diagnostic information using ultrasound. Smart Fusion minimizes this variability.

Smart Fusion can evaluate multiple focal lesions within a solid organ and visualize a specific lesion. For example, if a patient presents with multiple lesions, some being cystic and others solid, the operator can navigate through all the lesions individually and visualize and define each lesion and its proximity to any critical structures. Overall, Smart Fusion dramatically improves the accuracy of ultrasound in visualizing and identifying multiple focal lesions in an organ and improves the confidence of non-experienced operators.

Interventional applications

Smart Fusion improves interventional applications by reducing procedure times and providing a more comfortable patient experience. From a technical point-of-view, Smart Fusion enables different access points of view and orientations to be used that cannot normally be obtained with CT. It has the ability to predict the location of the bowel, colon and biopsy lesions that may not be seen well with ultrasound alone. Smart Fusion also minimizes misinterpretation of ultrasound artifacts, which is a major limiting factor with inexperienced operators, and decreases the number of non-diagnostic procedures.

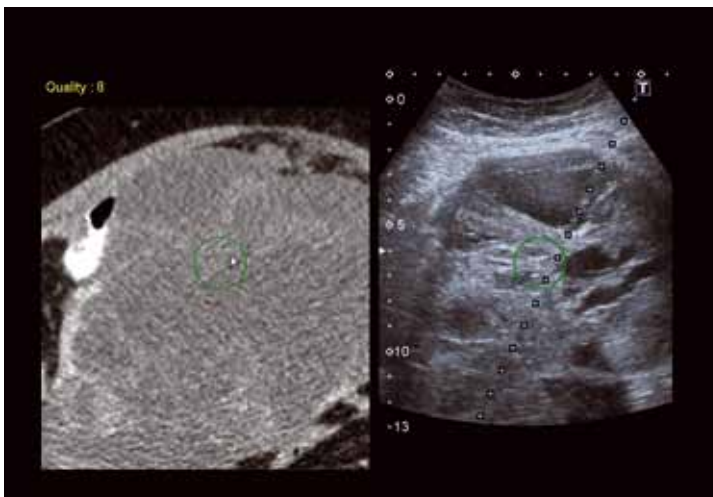


Fig. 3: A 80-year-old female with ovarian and colon cancer presented with a large pelvic mass. The mass is easily accessible using ultrasound guidance, but there is always concern for interposing bowel injury. Using Smart Fusion, the target was selected, the cystic portion of the mass was easily avoided, the bowel is clearly visualized and the bowel motion can be confirmed using real-time ultrasound assessment.

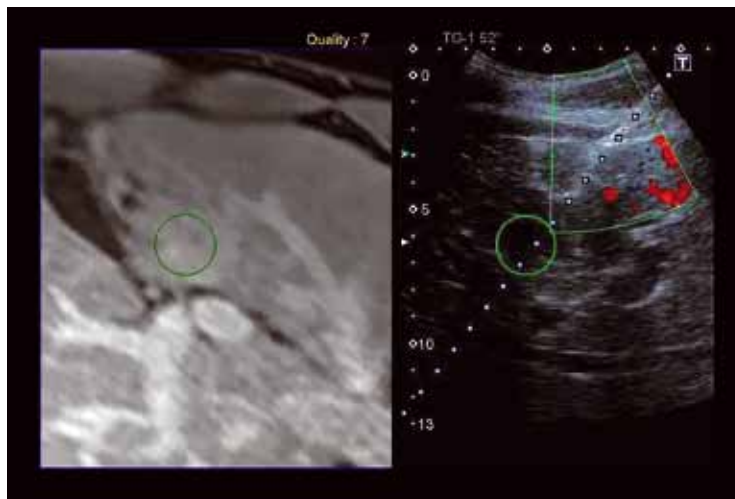
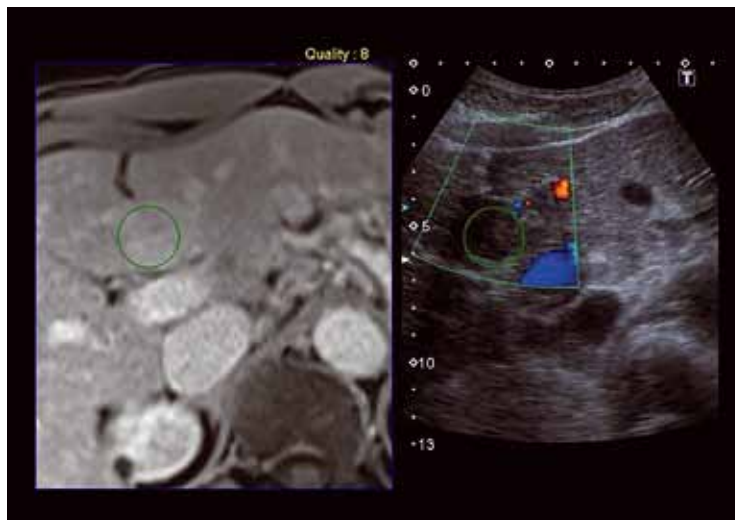


Fig. 4: A 35-year-old female with a renal transplant presented with worsening renal function and possible organ rejection. Previously acquired CT imaging is used for fusion, as avoiding the bowel is critical for this ultrasound guided biopsy. The bowel is clearly defined enabling safer intervention by avoiding damage to the bowel.

When performing biopsies, some lesions are questionably visualized or not visualized at all on ultrasound. Smart Fusion enables the operator to conduct biopsies with ease and confidence. In the case of multiple lesions in a solid organ, the lesion of interest

can be targeted more accurately using fusion than compared with ultrasound alone.

Any critical structure that is difficult to see on ultrasound, like bone, lungs or the colon can be clearly identified with Smart Fusion as the previously acquired CT or MR images follow the ultrasound transducer, improving patient safety and decreasing complications.



Figs. 5: Here, a 30-year-old male with a history of hepatitis C presented with an enlarging hepatic lesion shown on MRI near the gallbladder. The lesion is atypical for a carcinoma. A previous biopsy revealed an area of fibrosis (Fig. 5a), but the increase in size is indication for biopsy. Smart Fusion clearly visualizes the gallbladder to improve safety during the intervention (Fig. 5b).

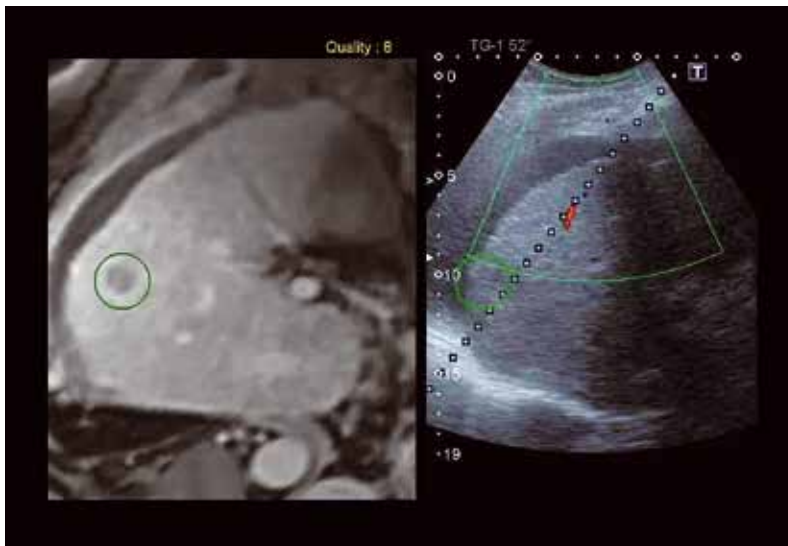


Fig. 6: A 55-year-old male with hepatitis B and liver cirrhosis presented with multiple lesions. On MRI imaging, the lesion is suspicious for malignancy, however this is atypical for this patient set. The lesion is poorly defined on ultrasound, but by using Smart Fusion the lesion is fully visualized and subsequent biopsy reveals hepatic carcinoma in the liver.

Therapeutic applications

Imaging-guided therapy plays an important role in any radiology department offering minimally invasive procedures like abscess drainages, placement of different catheters and shunts, placement of fiducial markers and tumor ablation.

One aspect of therapy-related treatment is abscess drainage. Typically, ultrasound is used in draining superficial abscesses, abscesses in solid organs or abscesses in the pelvis using transvaginal or transrectal drainages. Ultrasound has limitations in the abdomen, as it has difficulty imaging around the bowel. Smart Fusion eliminates this problem and will expand the utility of ultrasound for deep abdominal abscesses as well as lesions that are usually difficult to approach with ultrasound alone.

Tips for using Smart Fusion effectively

Initiating Smart Fusion is operator-based and needs to be done appropriately as misalignment will potentially result in an undesired outcome. After the fusion is achieved, operators should reevaluate by using different target points to ensure accuracy of the fused images before intervention is started. For example, in the liver, the transducer should be moved around to

ensure that all the vessels are appropriately matched on both imaging modalities as well as the gall bladder. Scans obtained recently should be used to minimize potential changes in the patient body. Also previously acquired images should not be used if there have been interval treatments that might affect organ alignment. Another critical step is to screen the patient for implanted devices. Finally, the fusion sensor on the unit needs to be close to the transducer. This can be achieved by changing the position of the patient, but after fusion has been achieved – the unit and the patient should not be moved to avoid misalignment.

A long way from the early days of matching functional ventilation-perfusion scans with chest X-rays, Toshiba's Smart Fusion is extremely valuable in numerous clinical applications and expands the use of ultrasound. By increasing ultrasound applications, patient safety is improved by lowering the use of radiation emitting modalities. It also is more cost effective than other imaging types and reduces healthcare costs for many common interventional procedures. As healthcare strives to be more efficient, integrating diagnostic procedures with Smart Fusion improves patient care and safety with more effective use of imaging.

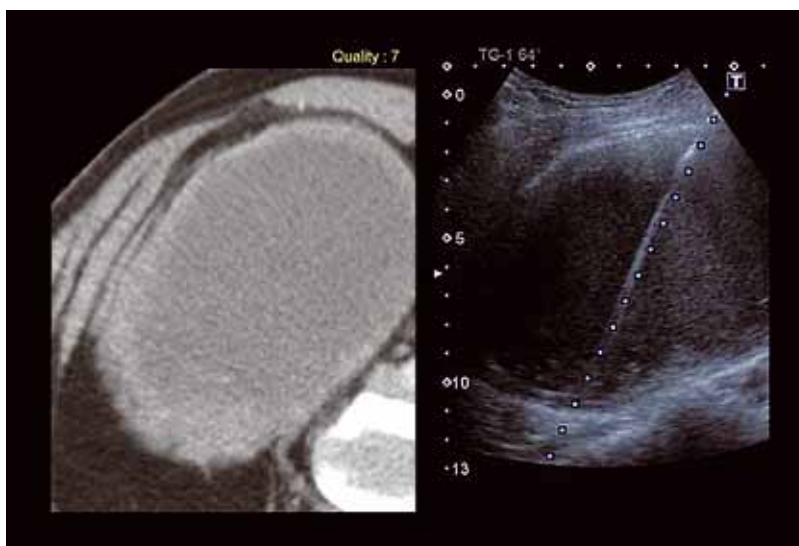


Fig. 7: A 55-year-old male referred with a pelvic mass biopsy, seen on a prior CT scan with no signs of fever or infection. Smart Fusion was used to avoid the bowel and hypogastric artery during the procedure.

Russian Lung Specialists Refine Imaging With Toshiba System

Toshiba's first new Raffine installed in Europe in the Tuberculosis Clinic No. 11 in Solnechnogorsk, Russia. Advanced image processing technologies integrated into the Raffine provide outstanding clinical images. 'Hard-to-see' areas and normally invisible areas are clearly visualized with this system.



Mobility with the flexibility of digital radiography/fluoroscopy won over the pioneering specialists at the Tuberculosis Clinic No. 11 in Solnechnogorsk, Russia. The clinic is one of the most advanced institutions in Russia. Its pulmonologists and radiologists are acknowledged pioneers of tuberculosis therapy and the specialist staff boasts some of the country's best trained experts for lung diseases. The new Raffine™ intelligent radiography/fluoroscopy (R/F) system for emerging markets provides outstanding clinical images. The new system is prov-

ing to be an excellent choice to meet the clinic's specialist needs.

The name 'Raffine' is taken from the French word raffiné meaning 'sophisticated' or 'elegant'. The Raffine system installed at Clinic No.11 is used to visualize the organs in the respiratory tract with radiographic and fluoroscopic imaging procedures. The new system features a 33 x 34 cm R/F flat panel detector (FPD) in its table and portable 35 x 43 cm radiography FPD in the vertical bucky stand, making it an ideal system for combined R/F procedures with



*Tuberculosis
Clinic No. 11 in
Solnechnogorsk,
Russia*



full chest imaging. The newly developed FPD for R/F imaging, with a pixel pitch of only 143 μm , ensures that the images obtained are clear and sharp. The Raffine's tabletop combines excellent mobility with the highest levels of patient safety and comfort, which is essential for examining lung disease patients. To support the complex and diverse needs of the clinic, the system is designed to make handling digital information as easy and convenient as possible. A variety of advanced image processing techniques are available to extract all of the important information from the high resolution images provided by the FPD.

To create the new 33 x 34 cm FPD, Toshiba made maximum use of technologies developed through extensive experience and research of a wide range of clinical data. The microfiber structure achieved by Toshiba's unique Caesium Iodide (CsI) deposition technique produces a highly advanced FPD with excellent resolution and brightness. The high resolution FPD has only recently been developed. It incorporates CsI film with microfiber structure, high brightness, reflecting film, and provides a large field of 33 x 34 cm. It has a dense pixel pitch of 143 μm^2 with a maximum density resolution of 14 bits. This is a high quality FPD that provides outstandingly sharp images. Toshiba's unique deposition technique allows CsI columnar crystals with a diameter of five to six μm to grow up to 600 μm . CsI films with high density, thick microfiber structure can be pro-

duced. CsI fibers light individually, achieving an FPD with high brightness and high resolution. A large 33 cm x 34 cm field of view is achieved. The field in fluoroscopic and radiographic images extends to all corners, and distortion is eliminated throughout the entire imaging area, from the center to the edges, ensuring high quality images.

Following Toshiba's ECO Style philosophy, the new Raffine is equipped with innovative, energy-reduction features for cooling the FPD. FPDs are sensitive to environmental changes and can generate artefacts with temperature variations. Normally, to prevent such problems the air conditioning system must be run continually to maintain temperature stability in the examination room, requiring a 24-hour power supply. The new FPDs however do not need a dedicated cooling unit which means installation space is reduced and cost efficiency is improved. Because the new FPD can be used at normal room temperatures, 24-hour power supply and strict room temperature control are also no longer required. For adaptability to environmental changes, highly airtight, moisture-proof film and hermetic sealing are used. Degradation of the FPD caused by moisture is prevented.

Advanced imaging techniques are integrated into the Raffine. 'Hard-to-see' areas and areas that would normally be invisible are clearly visualized with this system. Toshiba's development expertise has produced a system that incorporates high qual-

ity image processing software making it easy to acquire sharp diagnostically useful images.

In actual clinical practice, exposure doses and image levels are changed for each study, depending on the patient's physique, the region to be examined, and effects from direct X-rays and the beam-limiting device. It is therefore necessary to correct images using the optimal gamma curve according to variations in the window or image histogram. Toshiba's unique Auto Window function can generate the optimal gamma curve according to the distribution in the histogram of the acquired image. The acquired images are always optimized. In film/screen systems, or in conventional image processing, image correction cannot be performed properly in areas in which intestinal tracts with gas overlap, or when density variation is present in a single image, due to difference of the body thickness in bronchoscopy or biopsy. Advanced DCF corrects such black/white crush properly. Fluoroscopic Digital Compensation Filter (Fluoroscopic DCF) has been developed, which performs image processing equivalent to Advanced DCF for radiography in real time. Halation and black crush are minimized, providing clearer fluoroscopic images.

Increasing the number of pixels limits the acquisition rate or increases the file size, requiring a large storage area. Therefore, binning or resizing is generally performed to adjust resolution. How-

ever, a decrease of spatial resolution is unavoidable. MicroView™ (High Resolution) can output high resolution images using unbinned image processing. This function is suited to orthopedic studies or endoscopic retrograde cholangio pancreatography (ERCP), which requires more detailed fluoroscopic images than those acquired by standard fluoroscopy.

Usability of the Raffine is equivalent to a Toshiba digital radiography (DR) system. The viewability of the operating screen in the new system has been further improved, providing a comfortable operating environment. The image display area is now positioned at the center of the screen. The patient information display area, image processing buttons, thumbnails, image information display area, and print preview are appropriately positioned around the image display area for easy viewing, ensuring that the operator can concentrate on the examination. In addition, the progress of auto-filming can be checked on the same monitor.

With advanced image processing features for radiography and fluoroscopy, such as Toshiba's unique Digital Compensation Filter, and a versatile system design with two FPDs, the Toshiba Raffine is proving the perfect addition to the radiology department of Tuberculosis Clinic No. 11.

The Raffine's tabletop combines excellent mobility with the highest levels of patient safety and comfort. C'est raffiné!



Scottish Hospital Opts for Flexibility in X-Ray

Advances in digital imaging technologies and information technology have greatly expanded the range of applications possible with multi-purpose radiology/fluoroscopy (R/F) systems from general radiography to interventional catheterization procedures. Toshiba's innovative, multi-purpose, R/F system, Ultimax-i, features the latest technologies to accommodate specialists' needs for a system that can perform a wider variety of examinations with

minimal impact on the patient. With its unique system concept and large Flat Panel Detector, the Ultimax-i is one of the most versatile systems on the market and more than 40 have already been sold across Europe. One of the latest to be installed was selected by Lorn & Islands Hospital, Oban, Scotland. Visions spoke with Dr Peter Thorpe, Consultant Radiologist, Stan Porada and William Ramsay, Senior Radiographers at the hospital, about their experiences with the new machine.

Lorn & Islands Hospital in Scotland recently installed the multi-purpose R/F system Ultimax-i with large flat panel detector



VISIONS: Could you tell us a little about the unique setting of Lorn & Islands Hospital and the implications for healthcare provided by it?

Peter Thorpe: Lorn & Islands Hospital is situated in Oban, a small town in the Scottish Highlands with a resident population of 8,120. Despite its small size, Oban is one of the largest towns in the region and serves as a commercial center for the West of Scotland and the Scottish Islands. Lying off the Firth of Lorn, in a designated Area of Outstanding Natural Beauty, it also attracts up to 25,000 tourists during peak seasons, due to its picturesque location and the excellent opportunities for outdoor leisure pursuits in the surrounding countryside, including walking, climbing, mountain-biking, skiing, sailing, fishing and golf. Large numbers of tourists visiting the area mean that its local facilities, including the town's hospital, Lorn & Islands, often need to accommodate extra needs.



“ Peter Thorpe: Providing modern healthcare to a population dispersed over an area of 32,500 km² is a major and interesting challenge to all healthcare professionals, including radiology! ”



National Health Service (NHS) Highland, one of Scotland's 14 regional health authorities, manages the hospital. Geographically, it is the largest health board in Scotland, serving a catchment area of 32,500 km² from Kintyre in the South-West to Caithness in the North-East, and a total of 310,000 people. Within this territory, NHS Highland provides a wide range of health services, operates five hospitals, including Lorn & Islands Hospital in Oban, and employs more than 9,000 people, making it one of the largest employers in the region.

The Scottish Highlands are known worldwide as containing some of United Kingdom's most rugged and outstanding natural features. While this attracts tourists, it can also create some additional challenges in delivering health services due to difficult terrain, rugged coastlines, remote and difficult-to-access areas, including islands, limited transport and communications infrastructure. And while populations in the central areas within NHS Highland's catchment area are growing rapidly, remote populations are dwindling and ageing. Providing modern healthcare to a population dispersed over such a wide area is a major and interesting challenge to all healthcare professionals, including radiology!

VISIONS: What health services does the hospital provide?

Peter Thorpe: Lorn & Islands Hospital forms a hub for both acute and community services within the area. It was purpose-built in 1995 and houses a full range of facilities that you would expect to find in a rural general hospital, including 24-hour medical, surgical and anesthetic services. Most procedures are centrally performed through Lorn & Islands Hospital, although we also serve some outreach clinics for community hospitals throughout the Argyll re-



“ Stan Porada: We chose Ultimax-i because of its ease of use and the potential to accelerate workflow within the department. ”

gion. A comprehensive portfolio of diagnostic services is delivered on site, comprising a full range of radiology procedures, a fully accredited laboratory service and a broad range of endoscopy.

VISIONS: Why did you choose Toshiba's Ultimax-i?

Peter Thorpe: Lorn & Islands Hospital needed a truly multi-purpose X-ray system – one that was capable of performing plain radiography, fluoroscopy and gastro-intestinal procedures. Toshiba's Ultimax-i system, with its large 43 x 43 cm flat panel detector, proved to be the best choice for us. It offered a highly efficient solution, enabling all these procedures to be carried out on one system in a single examination room. The system brings with it all the benefits of flat panel detector technology, together with a comprehensive dose reduction program to provide a high-class versatile, all-round system with excellent image quality, whatever the application.

The new Advanced Digital Compensation Filter and Super Noise Reduction Filter (SNRF) add excellent image quality in plain radiography, making the Ultimax-i a perfect back-up system for the hospital's general radiography room. The latest software release for Ultimax-i offers further improvements in radiography and fluoroscopy image-processing.

Stan Porada: We chose Toshiba's Ultimax-i because of its ease of use, large field of view (FOV) flat panel detector and potential to accelerate workflow within the department. The Ultimax-i delivers every-



thing that clinicians require from a true, multi-purpose R/F system. We can perform examinations with increased efficiency, which is particularly important for acute care situations.

The large flat panel detector offers many benefits for image quality including lack of geometric distortion and improved ergonomics with better patient coverage. It also enables dose reduction. I really like the SNRF, which enhances image quality significantly in fluoroscopy. I find the overall examination experience is improved with Toshiba's Ultimax-i silent, liquid-metal bearing X-ray tube. With the resultant lower ambient noise level, I can communicate more easily and effectively with patients.

The applications and capabilities of the new system are tremendous and every day we learn new things about utilizing the system more and more. Initially, we anticipated use as a back-up for our general radiography system, but daily practice has demonstrated the benefits of using the multi-purpose system with low dose screening for complicated radiographic projections.

William Ramsay: The ease of use of the Ultimax-i is one of its greatest advantages. For radiographers, this starts with the outstanding flexibility of the C-arm with relation to the base of this multipurpose system. The system's physical adaptability, rapid table and C-arm motion mean that virtually any position and projection can be obtained rapidly and smoothly when capturing clinical images. The anti-collision technology of the system protects the patient at all times.

VISIONS: How is the support and service that you have received from Toshiba Medical Systems?



The Hospital is situated in a picturesque and rugged area: loved by tourists but challenging for physicians

Peter Thorpe: Lorn Et Islands Hospital is a relatively quiet infirmary. This has given me the opportunity to really interact with the whole Toshiba team from the initial investigation and demonstration through purchasing, installation, training and operation. It has been a very rewarding experience. Toshiba's guidance has been invaluable. Delivery of the system was swift. The installation team has provided expert advice to ensure that every aspect of operation has been considered in setting up the system

and integrating it seamlessly into daily use. And for the life of the machine, Toshiba continues to provide comprehensive technical support and applications.

Toshiba's service department has a very good reputation here at Lorn Et Islands Hospital. Regular scheduled maintenance is performed by the local service team, which leads to a guaranteed system uptime exceeding 98%. The support of Toshiba is outstanding. What I particularly like is that Toshiba really listens to its customers and I am able to dis-

Digital radiography of a knee, a foot and a hand





View of the DR room

“ Peter Thorpe: The guaranteed system uptime exceeds 98%, so support from Toshiba is outstanding. ”

cuss further requirements, issues and areas for system improvement with all staff.

Stan Porada: The continued support of the clinical applications team of Toshiba is outstanding. General radiography procedures are now carried out on both our general radiography Bucky system and the Toshiba multi-purpose room with Ultimax-i. As the imaging technology is new to us, the support from Toshiba is really appreciated. The knowledge

and skills of Toshiba's clinical applications team really made the difference for us. These guys really know what they are talking about!

Barium enema, a special x-ray examination of the large intestine



VISIONS: Why is Lorn & Islands Hospital such an interesting example for other radiology departments?

Scott Kearton, Account Executive, Toshiba Medical Systems Europe: Ultimax-i is Toshiba's solution to help many hospitals overcome declining reimbursements, competitive pressures, decreasing capital equipment budgets, and staff shortages, with a system designed to provide productivity enhancements at an affordable price.

The truly multi-purpose design of Toshiba's Ultimax-i system enables Dr Thorpe and his team at Lorn & Islands Hospital optimize utilization of the limited space available to them. With declining budgets, Toshiba's solution has provided a sustainable and future-proof solution for this hospital's digital radiography (DR) and radiology/fluoroscopy (R/F) imaging needs. The experience gained here helps Toshiba promote this beneficial concept to other radiology departments throughout Europe.

VISIONS: Thank you.



*From left to right:
Barry Callinan
(CT Clinical Specialist),
Dr Orla Buckley
(Consultant Radiolo-
gist), Matt Corcoran
(MD TOSHMedical),
Cees Verlooi (Toshiba
Application Specialist)
Dr Govender (Con-
sultant Radiologist),
Prof William Torreg-
giani (Consultant
Radiologist), Rose-
marijn Van Beurden
(Toshiba Application
Specialist).*

Wonderful perspectives for patients

Trees, colourful balloons floating in a blue sky – that's what patients will see during a scan with the newly installed Toshiba Aquilion PRIME scanner at Tallaght Hospital, Dublin, Ireland. The 'sky ceiling' has a positive effect on patients – children and adults alike – says consultant radiologist Dr Orla Buckley: "A typical scan can be a stressful experience for patients. They often feel claustrophobic when undergoing this type of test, but the

new scanner will reduce the need for sedation in patients." But the Toshiba Aquilion Prime has more to offer than a peaceful and serene sky: innovative, state of the art technology. As far as the hardware is concerned the scanner is fitted with a large 78 cm aperture and a table providing a loading capacity of 300 kg which makes scanning of larger patients easier. More importantly, the Aquilion Prime, like all Toshiba premium systems, includes AIDR 3D, a feature that takes diagnostic imaging to new dimensions. Great perspectives indeed!

New technology at Old Trafford

DHL is one of the main sponsors but as official Medical Partner of Manchester United Toshiba has delivered five ultrasound systems to the Trafford training centre in Carrington to complete the first stage in the development of the football club's state of the art medical imaging facility. The systems will allow the club to provide high quality, immedi-

ate and continual care for all players in the privacy of their training ground. Dr Steve McNally, lead club doctor, along with a team of physiotherapists and podiatrists will utilize the systems for onsite medical screening, fast and accurate diagnosis and individually tailored treatment plans.



*Dr Steve McNally (left)
and his team with the new
ultrasound systems*

Toshiba launches path-breaking image sensor

Toshiba Corporation today announced that it will launch a new 20 megapixel (MP) CMOS image sensor, the TCM5115CL, as the latest addition to its sensor line-up for digital still cameras. TCM5115CL offers the industry's highest resolution in the 1/2.3 inch optical format, using backside illumination technology (BSI) to improve sensitivity and imaging performance.

The TCM5115CL improves performance and picture quality with smaller pixels – a major challenge brought about by continued advances in the resolution offered by compact digital cameras.



Run the mile for the environment



TOSHIBA BATON is an exciting new website launched by the Corporate Environment Management Division. It allows Toshiba Group employees to post and share photos of eco activities.

An animated figure on the site runs a certain distance when posts and 'supports' from the viewers are recorded. When the runner reaches the goal, Toshiba will make a donation to an environmental cause.

The website is designed to improve information-sharing among employees and increase employee motivation for environmental activities. At the same time it seeks to enhance the brand of Toshiba Group by presenting the global activities to the public at large.

Currently, only employees who are in charge of environmental issues can post photos on the TOSHIBA BATON website. Anybody else who is interested is welcome to access the site, view posted photos and click on the "Support this runner" button of their favourite post.

Your kind support and participation are greatly appreciated.

CNN ECOSPHERE –Twitter 'n tweets for sustainability

When world leaders met in 2012 for the United Nations Rio+20 Earth Summit on Sustainable Development to make crucial decisions for the future of our planet www.cnn-ecosphere.com was designed to provide coverage of the global discussion on sustainability around the Summit.

ECOSPHERE is a real-time Twitter Visualizer that aggregates tweets tagged with #RIO20, orders them into specific topics or discussions and visualizes them in real time in the form of an evolving digital garden. Each tweet stimulates growth in a plant or tree in the garden. New thoughts are

planted as seeds, which grow as similar ideas are shared. The size, color and growth of these plants give users a real-time view of how the global discussion is evolving. At any time in the evolution of the ECOSPHERE, there are up to 30 plants growing on the surface of the sphere, representing the 30 most popular keywords or topics. Users can explore the lush 3D environment by zooming in on the different branches while a separate time line documents the development of the discussions and the ECOSPHERE environment itself. Users are recommended to access the web-based interactive ecosystem with the latest versions of Firefox, Google Chrome and Safari (with WebGL enabled). Plant a thought. Watch it grow.

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. 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



The Clinical Research Imaging Centre (CRIC) is based within the University of Edinburgh Queen's Medical Research Institute and incorporates multimodality human integrated imaging research. It is located in Edinburgh, Scotland and houses a Toshiba Aquilion ONE CT scanner.



Pittenweem from the outer harbour wall. The name derives from Pictish and Scottish Gaelic. "Pit-" represents Pictish pett 'place, portion of land', and "-enweem" is Gaelic na h-Uaimh, 'of the Caves' in Gaelic, so "The Place of the Caves"

Photography: Prof. Edwin van Beek,
Director of the Clinical Research
Imaging Centre
Text Source: Wikipedia
This page is based upon an idea
of Prof. Edwin van Beek.

The World of Imaging Meets in Vienna: An outlook on ECR 2013

*Toshiba Medical Systems
Satellite Symposium @ ECR 2013
"Clinical advances in multimodal
(per)fusion"
Moderator: Prof. Bernd Hamm,
Berlin, Germany
Saturday, March 9, 14:00-15:30,
Room E1*

From 7 to 11 March 2013 the European Society of Radiology, the world's largest radiological society, meets for its annual congress in Vienna, Austria. The ECR has become one of the most keenly anticipated medical conferences over the last two decades. On March 9 from 14:00 to 15:30 Toshiba Medical Systems presents even two Satellite Symposia. The first one, entitled "Clinical advances in multimodality applications", is showing new perspectives in perfusion and fusion imaging. The second one, named "Multimodal imaging for neuro applications", focuses on advanced neuroimaging.

Prof. Thomas
Fischer, Charité,
Berlin, Germany



The impact of smart fusion on the diagnostic outcome

In recent years, advanced techniques have revolutionized ultrasound (US). The new possibilities comprise techniques for optimizing image quality such as differential tissue harmonic imaging (THI) and frequency compounding (FC), tools for post-processing US raw data (ASQ and Precision Imaging) such as strain imaging (elastography), and the use of US contrast agents with new techniques (Fly-Thru; Image Fusion). The presentation will focus on characteristic features of abdominal organs, ma-

ignant liver lesions and prostate cancer detection using these state-of-the-art US techniques. For the improvement of the TRUS in the study presented here, we used ultrasound contrast agent imaging and compared it to magnetic resonance imaging (MRI), elastography, image fusion (ultrasound plus MRI) and histology after biopsy.

Learning Objectives:

- The participants will learn to use new US techniques for
1. Puncture and postoperative quality control using new US techniques.
 2. Detection of focal liver lesions and monitoring of therapy for liver metastases using Image Fusion.
 3. Presentation of examples to work out the benefits of Image Fusion in the field of prostate cancer detection and TRUS Biopsy.



Prof. J.-M. Correas
Necker University
Hospital, Paris,
France

CEUS of the kidney From new technology to patient management improvement

Contrast-Enhanced Ultrasound (CEUS) indications can be extended to renal diseases. New sequences have become available on several transducers including convex and linear probes and improve the sensitivity and resolution of the contrast modes. Together with Tissue Harmonic Imaging, the diagnostic performance of US has been improved particularly for the detection of small renal masses and the characterization of peripheral vascular disorders and atypical cystic masses. The percutaneous con-

servative management of renal masses benefit from both image quality and fusion imaging for guiding electrode placement and evaluating therapeutic efficacy. Applications such as 4D CEUS and quantitative assessment of perfusion should leave the research teams and become part of the clinical applications.

Learning Objectives:

1. To become familiar with new CEUS applications and settings.
2. To understand the classification of peripheral vascular disorders and atypical cystic renal masses.
3. To apply new US technology to percutaneous conservative management of renal tumors.

Dr J. Hermans
UMC, St Radboud,
Nijmegen,
The Netherlands

Liver and pancreatic perfusion using Aquilion ONE Vision

Only few studies have been published about CT perfusion of the pancreas, partly due to the small volume of coverage with previous scanners. With the Aquilion ONE Vision with a rotation time of 0.275s a volume with a coverage of 16 cm can be scanned, which makes it possible to scan the entire pancreas

and a major part of the liver. During free breathing of the patient multiple sequential time points are acquired to obtain a tissue concentration curve.

The time interval between acquisitions is small in the arterial phase (ca. 2s), is larger in the parenchymal phase (ca.5s) and increases to 1 min in the late venous phase. However, until now there is no scan protocol that has been optimized for pancreas perfusion. This includes the volume and rate of contrast

agent administration, kV and mAs, and the number of necessary time points. The number of time points should be minimized as with perfusion CT the radiation dose is substantial, even with the use of AIDR, and increases with increasing BMI (up to 45 mSv).

Because of movement of the pancreas in the z-axis during the acquisitions, the obtained high resolution perfusion images are registered in a non-rigid way, using one volume with maximal enhancement

as a reference scan. Subsequently, perfusion maps can be calculated based on different models.

Quantitative analysis of tissue microcirculation can possibly be used for biological characterization of solid pancreatic tumors and for evaluation of response to chemotherapeutic agents and/or radiotherapy. In the future perfusion parameters might be used to predict tumor aggressiveness and to design an individually tailored therapeutic approach.

Neuro applications using Aquilion ONE

The use of 320 row detector CT scanners in Neuro-radiology opens a range of new possibilities. The 16 cm volume acquisition allows whole brain perfusion imaging in stroke patients, and the combination with subsecond temporal resolution enables 4D- or time resolved CTA. The application of these techniques proves to be helpful in describing and understanding pathological processes but also in detection of specific neurovascular diseases. In this presentation the audience will become familiar with the properties of the CTA protocols used, and will learn about the neurovascular pathology, that can be depicted with these new techniques, through exemplary clinical cases.



*Dr P.A. Brouwer
Leiden University
Medical Center,
Leiden, The Netherlands*

Advance neuro-imaging at 3T with 32 channel head coil

High density array coils with 3T imaging improve dramatically the available signal-to-noise ratio (SNR), making a substantial reduction in scan time possible using parallel imaging to increase the spatial resolution of 2D and 3D acquisitions, allowing sub-millimeter voxel sizes within clinically acceptable acquisition times. A wide range of brain imaging MR applications can be improved using a high SNR 32 channel coil at 3T; with an in-plane resolution of 0.4 mm excellent details of the cortical and the deep gray matter structures can be captured. Using flow sensitive black blood (FSBB) imaging with an in plane resolution of 0.3mm, microvasculature

of the brain such as lenticulostriate arteries can be clearly visualized. With a parallel imaging factor of 4 a brain infarction protocol including a T2 weighted, a time-of-flight, a diffusion weighted and a perfusion weighted image could be scanned in 6 minutes or less.

Learning Objectives:

1. To understand the added value of high density array coils at 3T
2. To learn how to take advantage of the increased SNR at 3T to improve spatial and temporal resolution in advance brain imaging.
3. To apply new scanning parameters in fast routine brain imaging



*Prof. T. Okada
Kyoto University
Graduate School
of Medicine,
Kyoto, Japan*

Neurology interventions using Toshiba Infinix-i

In recent years, advanced techniques have been introduced in angiography (XR). The new possibilities comprise techniques for optimizing image quality during interventional procedures in neurology and the introduction of new imaging techniques like Volume Navigation - 3D Road Mapping, Needle Guidance, Low Contrast Imaging and Multimodality imaging

The presentation will focus on complex aneurysm interventions. The advanced angiography equipment we have at our department allows us to see the blood vessel, the aneurysm or AVM, and the microcatheter

all together continuously from the front and the side. Together with the 3D roadmapping and the CT multimodality it gives you during the embolization a higher sense of security and precision.

Learning Objectives:

The participants will learn to use new X-ray imaging techniques for

1. Visualization of aneurysm or AVM.
2. Use of advanced techniques like Volume Navigation - 3D Road Mapping, Needle Guidance, Low Contrast Imaging and Multimodality imaging
3. Presentation of examples to work out the benefits of new imaging techniques related to the interventional procedure in aneurysm or AVM treatment.



*Dr Hendrik Fransen
AZ St Lucas, Gent,
Belgium*

*Toshiba Medical systems satellite
Symposium "Big Equipment" @
ECR 2013
"Multimodal imaging for neuro
applications"
Moderator: P.A. Brouwer, Leiden,
The Netherlands
Saturday, March 9, 14:00-15:30,
Room F2*

TOSHIBA

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Saturday, March 9, 14.00 - 15.30 Satellite Symposia

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Join our Satellite Symposia on Saturday, March 9, 14.00 - 15.30

"Clinical advances in multimodality applications - new perspectives in perfusion and fusion imaging"

Room: E1

Moderator: Prof. Dr. Bernd Hamm, Berlin, Germany

- > Prof. Dr. Thomas Fischer, Berlin, Germany - "The Impact of Smart Fusion on the Diagnostic Outcome"
- > Prof. Dr. Jean-Michel Correas, Paris, France - "CEUS of the kidney: from new technology to patient management improvement"
- > Dr. J. Hermans, Nijmegen, The Netherlands - "Liver and Pancreatic perfusion using Aquilion ONE Vision"

"Multimodal imaging for neuro applications"

Room: F1

Moderator: Dr. P.A. Brouwer, LUMC, Leiden, The Netherlands

- > Dr. P.A. Brouwer, LUMC, Leiden, The Netherlands - "Neuro applications using Aquilion ONE"
- > Dr. Tomohisa Okada, Japan - "Advanced neuroimaging at 3T with a 32ch head coil"
- > Dr. Hendrik Fransen, AZ St. Lucas, Gent, Belgium - "Neurology Interventions using Toshiba Infinix-i"

We'd love to have you stop by our booth (#311) in Expo C

