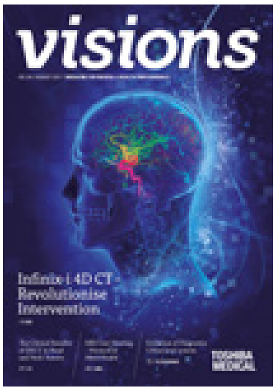
visions

NO. 29 // AUGUST 2017 // **MAGAZINE FOR MEDICAL & HEALTH PROFESSIONALS**

Infinix-i 4D CT - Revolutionise Intervention

// **X-RAY**

TOSHIBA MEDICAL



AT THE COVER

Color Coded Circulation provides Interventional Radiologists better identification of feeding arteries and AV shunts including flow evaluation.

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ISSN 1617-2876

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Time to write yet another editorial to you... a task that I enjoy immensely.
For this issue, I thought about addressing the topic of ***Artificial Intelligence***, deep learning, or, in short, AI. We see an increasing number of smart-, 'self-thinking' products around us. Products that anticipate our needs, by acting on assumed wishes and desires: self-regulating domotica, such as thermostats and lights that adjust to your preferred settings; your favorite coffee ready for you when you wake-up in the morning; self-catering refrigerators; and self-driving (and parking) cars. Until now, this intelligence was more or less focused on automating tasks that we find less important or work that is undesirable.

But what about finding cardiac arrhythmias with a precision that could be more accurate than those of professional cardiologists?[1] What about confirming or otherwise a cancer diagnosis in cases in which doctors are still unsure?[2]

One thing is certain, AI is bringing about change in each and every business sector.

In medical- and diagnostic imaging, all kinds of future visions of computers that compare thousands of images per second, search for a diagnosis and learn from any error ever made, are imaginable. Systems that, in turn, would create more time for doctors and specialists to spend on patient care and investigating unique, special and complex cases, for which little or no comparative information is yet available. Not a bad thing per se.

However, the scenario described above should obviously be considered as science fiction at this moment in time. Some say it is an absolutely impossibility[3], but then again...who knows?

Writing an editorial like this one could, if you believe some of the media, technically be done by AI in the near future[4]. However, I wonder if I would be able to recognize myself in a text composed by an AI system, and if I would experience the same joy and satisfaction reading it, as when I have written each character, line and paragraph myself? I don't know. Actually, maybe I would, but I'm just wondering if the AI system behind it would feel that way too?

Kind regards,

JACK HOOGENDOORN
Senior Manager Marketing
Toshiba Medical Systems Europe BV

1. *http://tinyurl.com/ya9xqtvm*
2. *http://tinyurl.com/hvu3shl*
3. *http://tinyurl.com/y9oc9hk4*
4. *http://tinyurl.com/ht70259*

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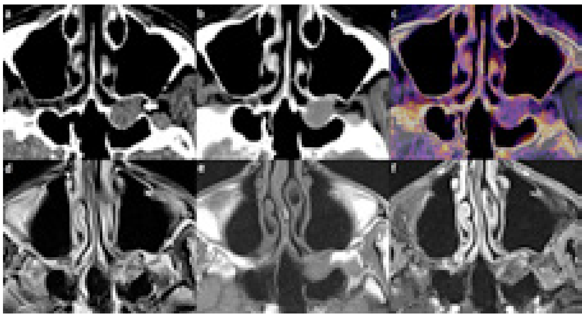
All New Products. All New Us.



// NEWS

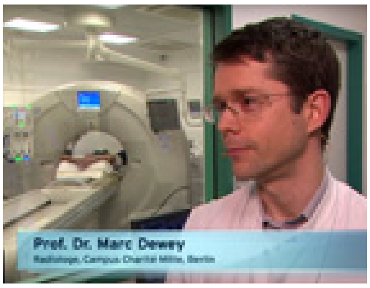
Mark Holmshaw appointed President and CEO of Toshiba Medical Systems Europe

Toshiba Medical has announced the appointment of Mark Holmshaw as the President and CEO of Toshiba Medical Systems Europe.

Mark has been working for Toshiba Medical for 27 years. Beginning as an engineer in Service, he moved into the Sales environment at Toshiba Medical UK before being promoted to the position of Vice President Sales, Marketing and Service at Toshiba Medical Europe in 2012. With an impressive track record in engineering, sales and management, Mark Holmshaw is looking forward to further strengthen and enhance the companies' position in the healthcare industry. Partnership, innovation and clear communication are key elements in his strategy to drive the business forward.

"I am grateful that I have been given the opportunity to use my strong people skills and years of knowledge and expertise in realising our challenging objectives and bring our organization to the next level." said Mark Holmshaw. "Key are our dedicated people and their friendly, professional and customer centric attitude. They are our main differentiator and something I strongly believe in: it's all about the people. I am confident that, now being part of the Canon family, our organization will become much stronger in every aspect of doing business and I'm looking very much forward to making this happen." //

Live Cardiac CT



Live Cardiac CT broadcasted on TV from Charité in Berlin, Germany with Professor Marc Dewey.

To view the video, go to Youtube: **http://tinyurl.com/y989fp2r**.

Further details about the study which runs in 14 European countries can be found at **www.dischargetrial.eu** //

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Symple is the easiest way to monitor the ebb and flow of your symptoms over long periods of time. Designed by patients, clinicians & care givers, Symple delivers an uplifting experience when you need it most.

Symple - Symptom Tracker & Health Diary' van Symple Health, Inc.
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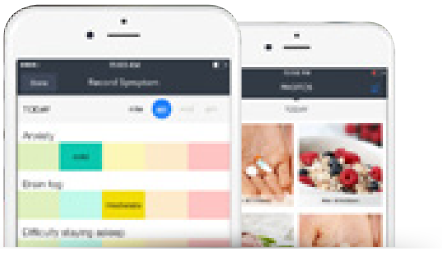


Can CT Myocardial Perfusion predict who will have a heart attack in the following 2 years?

On March 14th 2017 this question was answered with the online publication of the results of the CORE320 2 year follow-up in Radiology. 379 patients were followed for 2 years to see if they had adverse events (MACE) such as a heart attack, revascularization, arrhythmia or hospitalization for chest pain or congestive heart failure. The aim was to see if the combination of CT Angiography and CT Myocardial Perfusion was as good as the combination of Coronary Angiography (ICA) and SPECT to predict these events. Both techniques proved to have similarly high values for predicting MACE at two years after presentation and event-free survival. The two-year MACE-free rates for combined CT angiography and CT perfusion findings were 94 percent negative for coronary artery disease (CAD) versus 82 percent positive for CAD and were similar to combined ICA/SPECT findings (93 percent negative for CAD vs. 77 percent positive for CAD). **http://tinyurl.com/ycemvebn**

In summary, the CORE320 study continues to produce high quality research that has a significant impact on cardiac CT. //

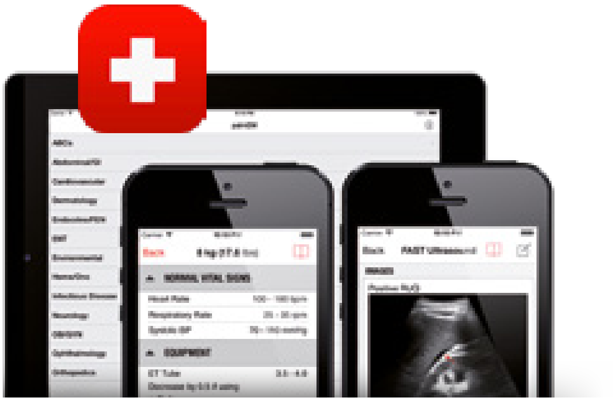
CORE 320

palmEM: Emergency Medicine Essentials & Urgent Care Quick Reference Pocket Guide

By palmER Worldwide LLC

Emergency Medicine in your palm
palmEM is an all-in-one, rapid and succinct, evidence based emergency medicine quick reference. The palmER emergency medicine app is used by tens of thousands of healthcare providers in over 120 countries.

palmEM is the ultimate app for any new or seasoned provider looking for something that distills down some of the new decision rules coming from current literature. No yearly subscription fees, always up-to-date and available for iOS and Android. //



Pre-1915 Woodblock prints and Drawings by Japanese Artists

Interested in old Japanse art? On the website of Library of Congress you will find more than 2,500 woodblock prints and drawings by Japanese artists of the 17th through early 18th centuries including Hiroshige, Kuniyoshi, Sadahide, and Yoshiiku.

Webpage:
http://tinyurl.com/ydy96uu6

The Library of Congress
The Library of Congress is the largest library in the world, with millions of books, recordings, photographs, newspapers, maps and manuscripts in its collections. The Library preserves and provides access to a rich, diverse and enduring source of knowledge to inform, inspire and engage you in your intellectual and creative endeavors. //

A modern version of the Tale of Genji in snow scenes by the artist Toyokuni Utagawa, (1853)

Traditional Japanese Art of Unlikely Objects by Keiko Masumoto

On the website of the artist Ms. Keiko Masumoto, you will find embedded traditional Japanese ceramic plates, bowls, and vases with unlikely objects.

Her work has appeared in numerous exhibitions in Kyoto, Tokyo, Kobe and internationally in London and Seoul. Keiko currently teaches at Kobe Design University, and is residence artist at Victoria and Albert Museum (London).

Website: **http://keikomasumoto.main.jp** //

Next page 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 Medical's systems are installed.

Every reader of VISIONS magazine 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 Medical system(s) installed. The complete result is shown on the opposite page.

Send your pictures and texts to: jack.hoogendoorn@toshiba-medical.eu,

►

The Basilica of the Sacred Heart of Paris, known as Sacré-Cœur Basilica, is a Roman Catholic church and minor basilica, dedicated to the Sacred Heart of Jesus, in Paris, France. The basilica is located at the summit of the butte Montmartre, the highest point in the city.

The Sacré-Cœur Basilica was designed by Paul Abadie. Construction began in 1875 and was finished in 1914. It was consecrated after the end of World War I in 1919.

Text Source: Wikipedia – Photography: Jacqueline de Graaf

The Saint Louis Hospital in Paris is recognized as a leading cancer center in France worldwide. It has developed expertise in the treatment of patients with breast-, skin-, colorectal-, and urinary tract cancers in particular.

With a new Infinix-i 4D CT system from Toshiba Medical, it is pioneering new interventional radiology techniques. Mrs. Eve Parier, General Manager of the hospital and Prof. Eric de Kerviler, Head of Interventional Radiology, explain in an interview how the Infinix-i 4D CT supports progress in interventional radiology and oncology. Read the whole interview on page 28 of this VISIONS magazine.

TOSHIBA MEDICAL

Made For life

CIRSE 2017 | 16-20 September

Copenhagen, Denmark

Monday, September 18, Lunch Symposium

Infinix-i 4D CT: The Future of Today in Interventional Radiology

13:00-14:00 hrs, Room: Auditorium 15

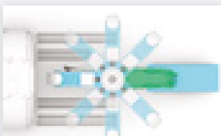
Chairman: Prof. Y. Arai, National Cancer Center Hospital, Tokyo, Japan

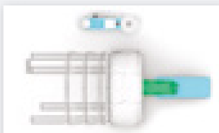
"Interventional oncology beyond liver interventions"
Prof. E. de Kerviler, Saint-Louis Hospital, Paris, France

"Is 3D information enough for sophisticated IRs?"
Prof. Y. Arai, National Cancer Center Hospital, Tokyo, Japan

"Infinix-i 4D CT - new milestone in liver interventional oncology"
Prof. B. Guiu, University Hospital Montpellier, France

One Room. One System. One Procedure.
Toshiba Medical's ground-breaking new Infinix-i 4D CT supports you in bridging the gap between the interventional lab and CT with one seamlessly integrated solution. The system eliminates the need to transfer patients back and forth between different rooms, while minimizing dose and maintaining patient safety. Helping to save valuable time and gain efficiencies with the ability to plan, treat, and verify in the same room, on a single system.


270 degrees of freedom


Convenient C-arm parking position


Infinix-i 4D CT: the most powerful Angio CT system

Infinix-i 4D CT

SEE. DIAGNOSE. TREAT.

www.toshiba-medical.eu

"Healthcare: an important part of Canon's growth vision."

I would like to share my thoughts now that six months has passed since Toshiba Medical Systems Corporation officially joined the Canon group. On April 1 of this year, I was appointed as a senior corporate executive of Canon. On the same day, Canon established the Medical Business Headquarters and I was also appointed to serve as the head of the organization. I will continue my efforts to maximize the synergies of our integration in order to further develop the healthcare business, which is an important part of Canon's growth vision.

We are currently working on various internal and external procedures related to the change of the company name scheduled to occur at the beginning of next year. At the same time, we have started several projects aimed at incorporating some of Canon's advanced production technologies at our production sites in order to improve operational efficiency and manufacture even higher quality products. We are also in the process of considering as many as 50 projects aimed at the development and commercialization of new technologies created by integrating some of Canon and our advanced technologies. We are going to catalyze this integration in order to create new synergies in technology and accelerate the delivery of innovations based on these synergies to our customers.

Our company is undergoing its greatest change since its foundation. We are treating this change and transformation as an opportunity for evolution and advancement, and are proactively using this opportunity to work together coherently on various internal activities to create a strong and vibrant corporate culture.

We receive feedback from patients commenting on their experience during exams. This plays a fundamental part in how we continuously consider the role that we must play as a medical systems development company in maximizing patient comfort & in our products offering the best possible patient experience.

Under our management slogan "Made for Life", with all of us in the Toshiba Medical Systems Corporation group working in unity based on shared values, we will continue to move forward together with our customers in order to contribute to medical care throughout the world.

TOSHIO TAKIGUCHI
President and Chief Executive Officer
Toshiba Medical Systems Corporation

TOSHIBA MEDICAL

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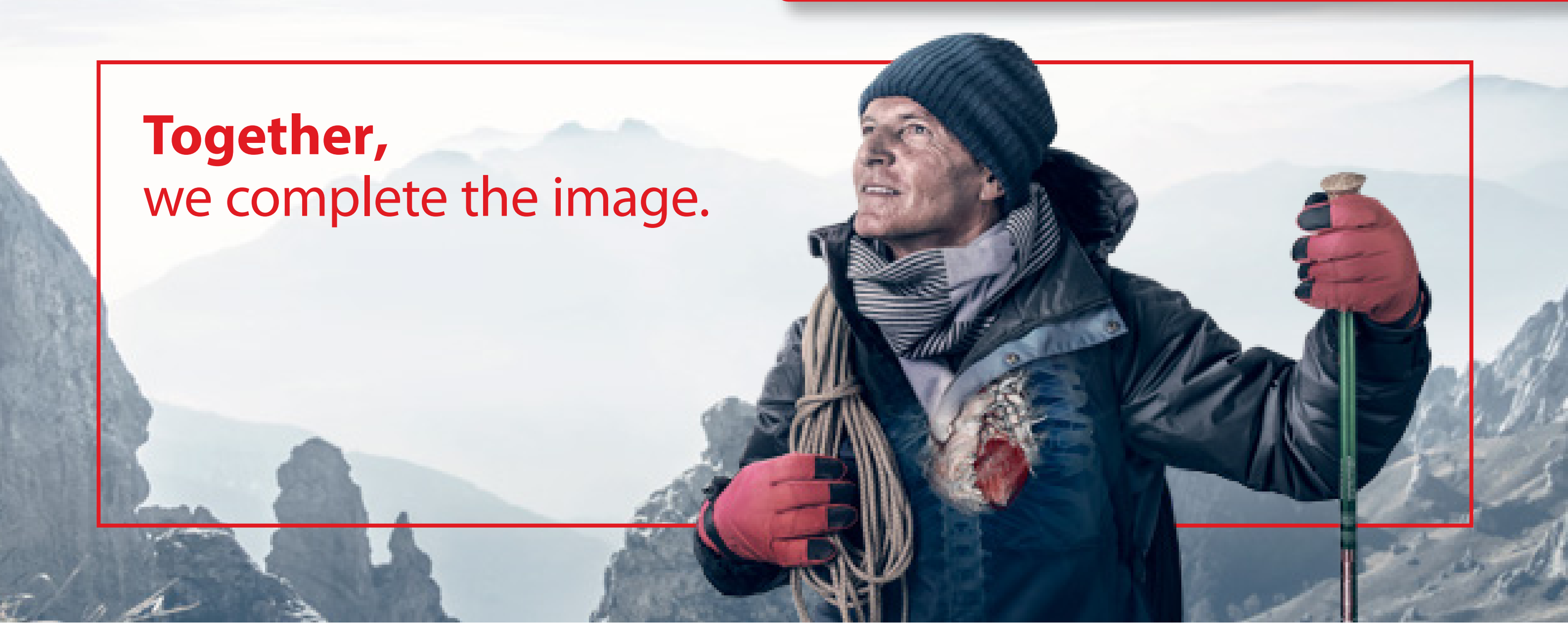
CANON GROUP

All New Products. All New Us.



Toshiba Medical is now part of the Canon family. So the same source of abundant innovation and technology leadership today is supported by our committed new ownership.

At Toshiba Medical we are dedicated to improving image resolution in every modality:

- **CT:** Improve high contrast spatial resolution with FIRST (MBIR) by up to 129 percent*, with the new Aquilion ONE™ / GENESIS Edition.
- **MR:** Boost diagnostic imaging with up to 20 percent increase in signal-to-noise ratio (SNR) with $^{\text{PURE}}$RF and Saturn technology in the Vantage Galan™ 3T. These images are real, not synthesized.
- **Ultrasound:** Expand the clinical applications of ultrasound with the new Aplio™ i-series. You can see more and do more with its newly engineered hardware and applications that enhance penetration and resolution.
- **Angiography:** Roadblocks are cleared away by design. 3D imaging anywhere is a real possibility with the Infinix™-i Sky + system.
- **X-ray:** Expand the capabilities of limited R&F room space with Toshiba Medical's Ultimax™-i FPD, making advanced imaging technology and diverse multipurpose system performance truly attainable.
- **Informatics:** Capitalize on the high-quality images across all these modalities using advanced visualization data management, and analytic solutions from Vital, delivered by Toshiba Medical.

Toshiba Medical has been adding strength to strength. As part of the Canon group, we'll be even stronger.

Follow us: www.toshiba-medical.eu

*Compared to filtered back projection (FBP) on the Aquilion ONE ViSION (TSX-301C) system.
The Infinix-i Sky + is the INFX-8000C with 930A C-arm.

Made For life

Prof. B. Guiu
Head of the Radiology Department

Infinix-i 4D CT

Advanced Interventional Radiology Techniques for Treatment of Primary Liver Cancer in France

The University Hospital in Montpellier, France, is a unique regional health center specialized in the treatment of patients with liver cancers. The center contributes to developing new treatments of these cancers through advanced Interventional Radiology techniques. With a growing Radiology Department, the center has recently acquired an Infinix™-i 4D CT system from Toshiba Medical. Mr. Le Ludec, General Manager of the Hospital and Prof. B. Guiu, Head of the Radiology Department describe how the new system has enabled the hospital to bring innovative new Interventional Oncology techniques, such as tumor thermoablation, into daily practice.

New treatment options for liver conditions are emerging fast. Public health issues including rising levels of obesity and type 2 diabetes have created an increase prevalence of metabolic liver diseases, such as Non-Alcoholic Fatty Liver Disease (NAFLD). Research into treatment of these conditions has also enhanced our knowledge of other liver diseases including primary liver cancers, which are often complex. Interventional Radiology has an important role to play in effective treatment of liver disease. Minimally invasive techniques, such as liver ablation, are recommended for almost 50% of primary liver cancer cases.

The University Hospital in Montpellier has a strong, dynamic and diverse team of committed, specialized professionals, who strive to provide the best care for cancer patients in the region, including transplant surgeons, liver disease-, anesthesia- and resuscitation specialists, and Interventional Radiologists. The team of five senior radiologists, six interns and 28 technicians will be expanded with three additional physicians, who will join the team next year. All radiologists in the department are active in Interventional Radiology.

"Our expert team works continually towards improving patient care," said Mr. Le Ludec. Direct recruitment of radiologists in hospitals can be difficult in France, as many prefer to be self-employed, but the opportunity to practice Interventional Radiology has encouraged many of our specialists to stay within the hospital system."

Interventional Radiology - An Emerging Field

"Our use of Interventional Radiology has increased by 400% over the last three years," said Prof. Guiu. "Our current priority is to develop techniques on thermoablation of tumors of the liver using multi-modality imaging, which combines CT scan, ultrasound and angiography. Nearly 40% of liver tumors are not detectable with ultrasound and 20% cannot be picked up with CT scanning. The combination of these imaging modalities, as well as the ability to mark the tumors endovascularly, has enabled us to perform three times more thermoablation treatments over the last three years with subsequent Interventional follow-up.

"We had been using a single dedicated scanner for diagnosis and treatment of these complex procedures. However, high demand for procedures created waiting times of more than six weeks for patients. This is not acceptable in oncology." Mr. Le Ludec explained. "With a realistic assessment of the number of patients that our center could treat and by weighing up the costs and benefits, we decided that investment in an Infinix-i 4D CT system

Prof. B. Guiu

"It has increased work-flow and significantly reduces waiting times for patients."

from Toshiba Medical and re-equipping the angiography room would be the way forward. The new Angio CT system is located in the operating room to facilitate access to anesthesiology and for patient security. Our team have been fully trained in using the new system."

Superior Image Quality

Prof. Guiu and his team find the image quality of the angio system excellent. The very low radiation exposure is a real bonus. They find the tools for reduction of radiation exposure with the Infinix-i 4D CT really efficient and easy-to-use in daily practice.

The team were also particularly impressed by the ease and speed of performing a CT acquisition during angio procedures, as compared to their previous system, which was a Cone Beam CT (CBCT) based system. They were convinced that image quality was better and the field of view size larger than CBCT.

"Image quality of CT-arteriography using only one rotation with 16cm spatial coverage is much better than any Cone Beam CT system," he said. "By comparison, the speed of acquisition in the workflow of angio procedures is also surprising."

Prof. B. Guiu
Prof. Guiu studied Radiology at the University Hospital of Dijon, then in the Interventional Radiology departments of the Gustave Roussy Institute and the University Hospital of Lausanne in Switzerland. He was appointed Professor and Hospital Practitioner at the University Hospital in Montpellier in September 2014 and became Head of the Department of Diagnostic and Interventional Radiology of the St-Eloi Hospital. He is an expert in both percutaneous and endovascular hepatic Interventional Radiology and research into Interventional treatment of tumors of the liver, in which, he coordinates several Phase I and Phase II trials. The University of Montpelier has four Radiology departments that cover all sub-specialties. The Radiology Department is highly specialized in digestive imaging.

Mr. T. Le Ludec
Mr. T. Le Ludec has been Managing Director of the University Hospital of Montpellier in France since 2016. He has worked in many medical facilities in France: at the University Hospital (CHU) in Lille, the public hospices (hospices civils) of Lyon, and also in management at the North Seine and Marne (Nord Seine et Marne) Hospitals. During his career, he has also been the Director for improvement of quality and safety of care at the French national health authority (HAS).

Minimal Training
Even with such high-level technical capabilities, the team at the hospital find the Infinix-i 4D CT very easy to handle in daily practice. However, some training in combining the dual modalities offered by the Infinix-i 4D CT system was required.

"Using the new system is not simply a question of adding a new angio suite and a CT system. We had to learn how to extract the right information from the CT for the angio. However, ease of use of the system was surprising; most functions are very easy to use in daily practice, and we were already able to use the most advanced functions of the system after one month," remarked Prof. Guiu. "We have created a group of intensively-trained radiographers that can work with the system's full range of functions, including reconstructions. The group shares information on using the system - overnight and at weekends too - to continuously advance our knowledge of the system and ensure that users have a minimum competence level."

A True Hybrid System
The Infinix-i 4D CT is not only the consolidation of two modalities, but a true hybrid system with a permanent communication between these two modalities.

"With the new system installed, we are now able to perform a wider range of Interventional procedures, including liver ablations, chemoembolization, radioembolization, implantation of ports for hepatic arterial infusion of chemotherapy, biliary drainage and stenting, and portal- and hepatic vein embolizations," said Prof. Guiu. "The 4D capabilities enabled by Toshiba Medical's Aquilion™ ONE technology are fascinating and will change our treatment evaluation practices; pre-, during and post-therapy. The large spatial coverage (16cm) provided by the CT allows coverage of the full liver in only one rotation. It opens the gate to true 4D imaging through many applications. We are working to replace the classical workflow of angio procedures with two 4D acquisitions, providing information, such as liver vessel anatomy, tumor-feeding vessels, tumor perfusion and flow, with less radiation exposure than classical techniques. Equally importantly, it has increased workflow and significantly reduces waiting times for patients."

"Having the chance to acquire the first Infinix-i 4D CT system in Europe with Aquilion ONE has been very exciting, but was also a difficult choice to make in the absence of external advice or reference point with relevant activities similar to mine," said Prof. Guiu.

Indisputable Reliability
The Radiology team have found the support provided by the Toshiba Medical to be excellent from the beginning of the acquisition of the new system.

"The support and information provided by Toshiba Medical has been amazing, and in retrospect, I must say that everything that they promised has turned out to be true in practice," added Prof. Guiu. "We benefited from a pre-training course and a very close multidisciplinary application follow-up in the early stages and were ready to start with full use of the system within two weeks."

Mr. T. Le Ludec

"We have formed a great collaboration with the company in the development of new tools and hardware upgrades."

"Toshiba Medical has provided very efficient support in system acquisition and installation of the Infinix-i 4D CT, and the partnership continues to strengthen," added Mr. Le Ludec. "We have formed a great collaboration with the company in the development of new tools and hardware upgrades. The reliability of this collaboration is indisputable and is a particularly strong indicator for success."

A Unique Imaging System

The new room that was installed in the operating room enabled the hospital to free up time that was dedicated to Interventional Radiology on the scanner of the Department of Radiology at St-Eloi. This enabled shortening of the waiting time for diagnostic scanners and also increases the profitability of this machine. With optimization of anesthetic resources in the operating room, more patients can be treated and waiting times before treatment reduced.

"Finally, it has been possible to increase our Interventional Radiology activities in compliance with the ISO Human Resources standards, with an imaging system that can do everything!" said Mr. Le Ludec. "The Infinix-i 4D CT technology allows development of innovative minimally invasive care for tumors of the liver and shorter durations of stay for the patient. Any medical center that wants to renew an angio-suite should at least consider the Infinix-i 4D CT as an option instead, given the additional possibilities offered by this technology."

"Having all imaging modalities in the same interventional suite located in the operating room allows the development of any percutaneous, endovascular or combined treatments within a secure context. The limitation is only that of your imagination." added Prof. Guiu. //

The Clinical Benefits of Dual Energy CT in Head and Neck Tumors

Mario Farah, M.D., Prof Arthur Varoquaux M.D., Ph.D.

Radiologic assessment has become an essential tool for the diagnosis and management of various diseases. In the head and neck region, medical imaging is widely used in different investigations, such as, evaluation of inflammatory sinus diseases and their complications, as well as surgical planning[1]. It is also utilized for diagnosing head and neck tumors, and assessing their extent and grading [2, 3] prior to planning therapy.

With recent technologic advances, CT is now faster, has higher resolution, and has a greater anatomical coverage than ever before. Nowadays, it is capable of material characterization and other applications with the dual-energy technique[4].

Several applications of Dual Energy Computed Tomography (DECT) are in clinical use: in cerebral imaging to differentiate intracranial hemorrhage from iodine extravasation after intracranial aneurysm embolization; urinary stone analysis to identify the stone's material composition (calcium stones versus uric acid stones); in joint imaging to detect and calculate the volume of uric acid deposition in gout tophus; and in chest imaging to evaluate the severity of acute pulmonary embolism[5,6,8].

Applications for other body regions, in particular for the head- and neck region, are under investigation, with some publications concerning the usefulness of DECT for the evaluation of cartilage invasion in laryngeal and hypo-pharyngeal cancer[9], as well as for cervical lymphoma staging with a preserved image quality and reduction of patient dose in comparison with the regular single energy CT[10].

This article highlights, via three examples, the usefulness of DECT in the diagnosis and evaluation of head and neck tumors.

DE Technique

The basic principle of dual energy computed tomography (DECT), or spectral imaging, is to obtain two datasets with two different kilo voltage peaks (for example, 80 and 135 kVp) from the same anatomic region. Material decomposition, based on the attenuation differences at different energy levels[7] is performed.

DECT generates various images which are used for diagnosis: the original 80 kVp and 135 kVp images, blending images generated by weighted average processing, iodine maps and virtual non contrast (VNC) image.

In contrast to the high kVp images, the enhancement is increased in the low kVp images, due to increased photoelectric absorption and decreased Compton scattering. For the assessment of vasculature, image quality can be significantly improved by lower energy dataset. However, these lower energy images are noisier compared with single energy computed tomography (SECT) imaging. Conversely, dataset noise is lower with 135 kVp.

The weighted average image (or blending image) is the result of the combination of the Hounsfield Unit (HU) data acquired by two different energies. The advantages of this combination are high contrast and low noise, optimal lesion conspicuity, and artifact suppression resulting in much better image quality for the diagnosis. Depending on some manufacturers, the proportion of data from 135 to 80 kVp could be adjusted by using dedicated DE post processing software that generates a series of weighted average image datasets using different weighting factors.

The weighting factor is the ratio of the image information derived from both image sets[8]. For example, 0.4, 0.6, and 0.8 blending image datasets incorporate 40%, 60% and 80% of the 80 kVp data, respectively.

Post processing enables iodine subtraction from all regions of the image, generating a virtual unenhanced image, with the possibility to generate iodine distribution images or maps. The calculated iodine distribution of an image is color coded and superimposed on the original 135 kVp images[4].

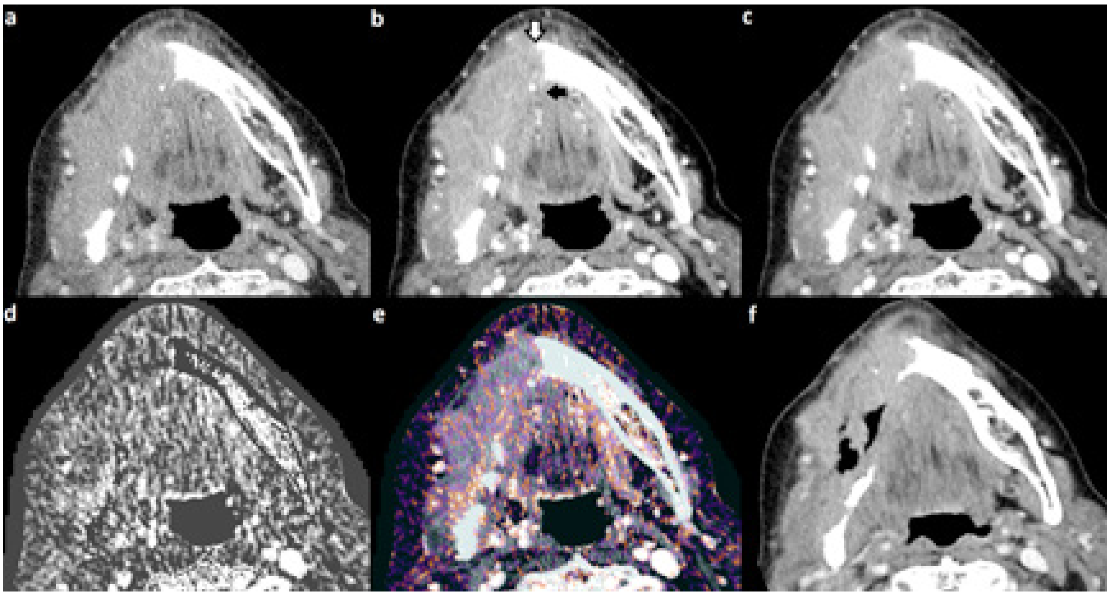
All three CT examinations in this article were performed using a 160-slice CT scanner (Aquilion® PRIME, Toshiba Medical). Dual energy helical scanning alternates between high peak kilo voltage (135kVp) and low peak kilo voltage (80 kVp) with each gantry rotation, with a switching time of 0.1-0.2 seconds. The mA settings are automatically adjusted for each kVp to provide image volumes with similar noise characteristics. The pitch is automatically adjusted.

For each examination, a non-enhanced acquisition was obtained, followed by a dual energy acquisition at 60 seconds after intravenous administration of iodinated contrast media.

The following image datasets were also obtained: pure 135 kVp, pure 80 kVp and 110 kVp weighted average (blending) image that incorporated 40 % of the 80 kV data and 60 % of the 135 kV data. The iodine distribution map was generated for each examination.

Case 1:

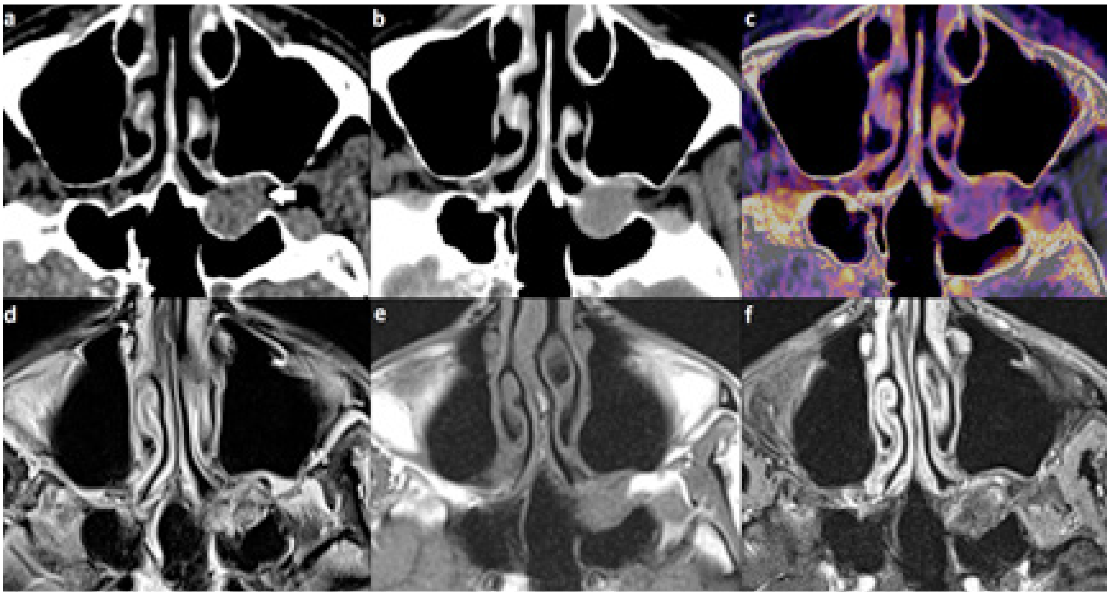
Right mandibular soft tissue lesion in a 90 year-old female patient presenting with right cheek swelling. Suspicious tumor of the internal surface of the cheek and of the floor of the mouth was detected by clinical examination. DECT was performed for evaluation and tumor staging. The 110 kVp blending image dataset showed a soft tissue minimally enhancing lesion invading the mandibular bone with massive osteolysis, as well as the tongue and the floor of the mouth. The tumor was classified as T4 (according to TNM classification) based on bone and muscle involvement, as detected by DECT.



Right mandibular soft tissue tumor with osteolysis (white arrow) and muscular involvement of the right mylohoid muscle (black arrow), classified T4 (according to TNM classification). a: 135 kVp. b: 80 kVp. c: 110 kVp WA. d: iodine map. e: iodine map fused with 110 kVp weighted average. f: mouth opened maneuver with 110 kVp.

Case 2:

Adenoid cystic carcinoma of the pterygo-palatine fossa in a 35 year-old female patient presenting with left maxillary pain. The DECT showed a soft tissue lesion of the left pterygo-palatine fossa, with a mass effect on the anterior wall of the left sphenoid sinus associated with osteolysis. The minimal enhancement of the lesion was more conspicuous on the 110 weighted average image dataset, which was comparable to the gadolinium enhancement on MRI. The iodine map increased the visual detection of the lesion's enhancement and maintained good anatomical detail.

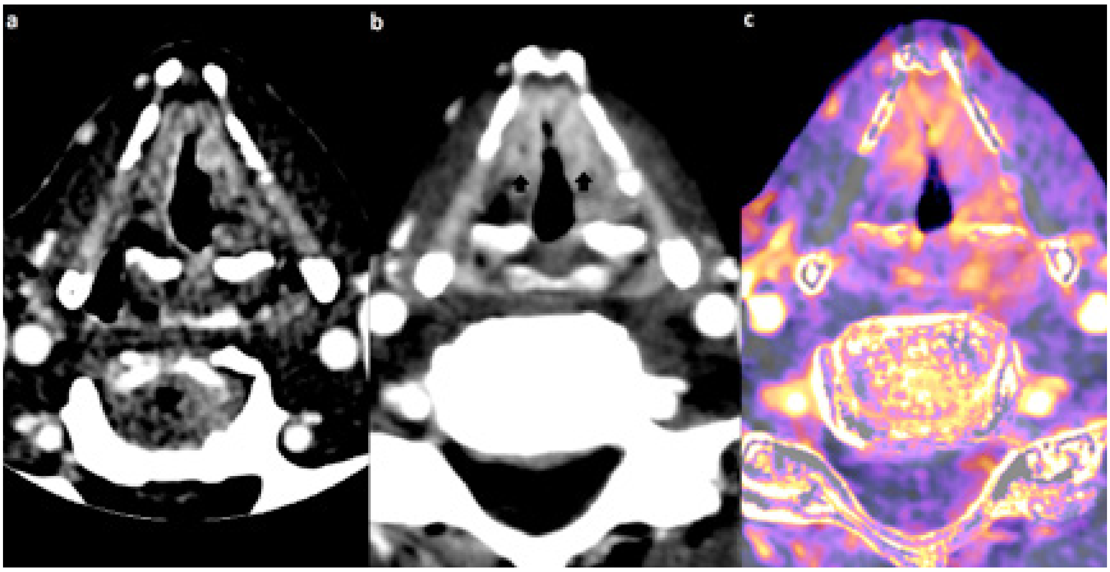


Adenoid cystic carcinoma of the left pterygo-palatine fossa (white arrow). Note the minimal enhancement of the tumor, which is better visualized with the iodine map. a: Non-enhanced. b: 110 kVp weighted average. c: iodine map. d: T2 weighted average MRI sequence. e: T1 weighted average MRI sequence. e: T1 Fatsat enhanced MRI sequence after IV gadolinium administration.

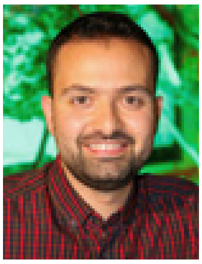
Case 3:

Soft tissue supra-glottic lesion in a 48 year-old male patient presenting with laryngeal pain of two months duration. Laryngoscopy showed a soft tissue lesion of the supra-glottic region, for which a DECT scan was ordered to evaluate the lesion's extension.

The DECT showed an anterior hemi-circumferential enhancing soft tissue lesion of the supra-glottic region. The lesion enhancement was more conspicuous on the 110 weighted average image dataset and on the iodine map, as compared with the SECT, with no thyroid cartilage invasion. The tumor was classified as T3 according to the DECT results, permitting a conservative non-surgical treatment with chemotherapy. //



Soft tissue anterior hemi-circumferential supra-glottic lesion (black arrow) with no cartilage involvement, classified T3 (according to TNM classification). a: SECT. b: 110 kVp weighted average. c: iodine map



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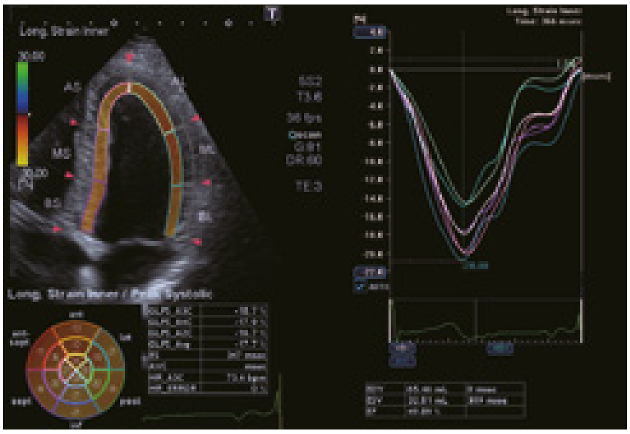
Wall Motion Tracking on Xario 200:

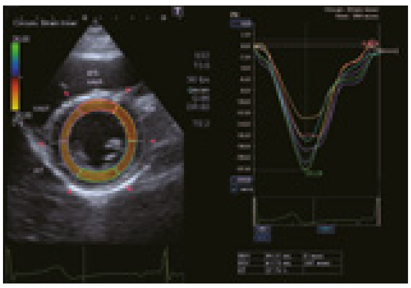
A Comprehensive Cardiac Solution in a Small Package

Wall Motion Tracking technology provides immediate visual quantitative access to global and regional myocardial wall motion dynamics. This technology is now available on Xario 200 Platinum Series, enabling clinicians to perform a more advanced cardiac examination during daily routine scanning. The increased cardiac performance of Xario 200 together with the system's versatility and mobility offer a powerful combination for cardiology and shared service departments with a high patient throughput.

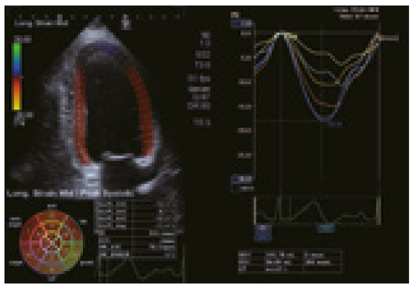
Wall Motion Tracking on Xario 200

- Highly accurate tool to analyze regional myocardial deformation by using speckle tracking techniques
- LV Volume and EF are calculated automatically in an instant
- Parameters such as Strain, Strain Rate and Rotation allow further assessment of the LV function
- Parametric images enable you to see the regional performance of the myocardium at a glance
- An intuitive Polar Map shows LV global function from 2 ch, 3 ch and 4 ch analysis results
- A graph displays value changes throughout the cardiac cycle
- A numerical chart provides detailed information that includes peak values, mean and SD
- DICOM data allows you to analyze Wall Motion Tracking anytime

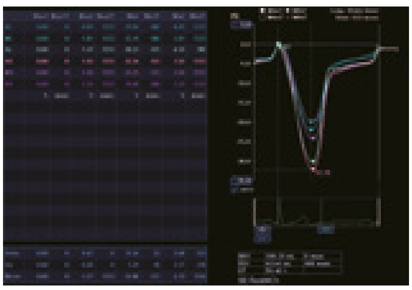




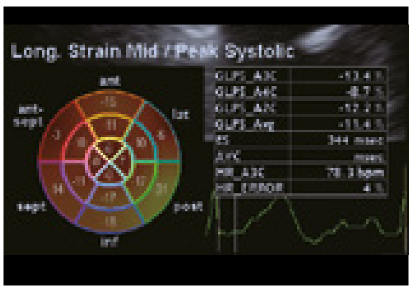
Circumferential Strain



Low Longitudinal Strain Value in Apex



Numerical Chart and Graph



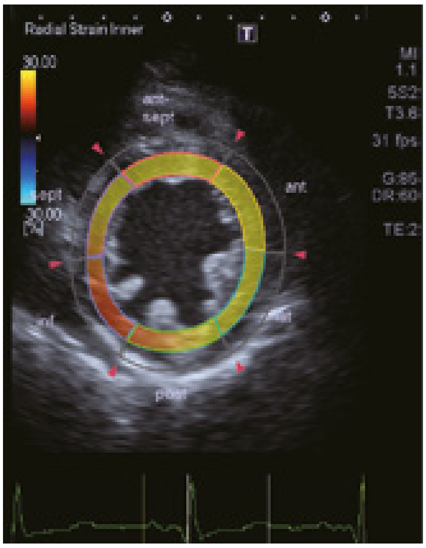
Polar Map with Global Strain

Early detection of ischemic disease

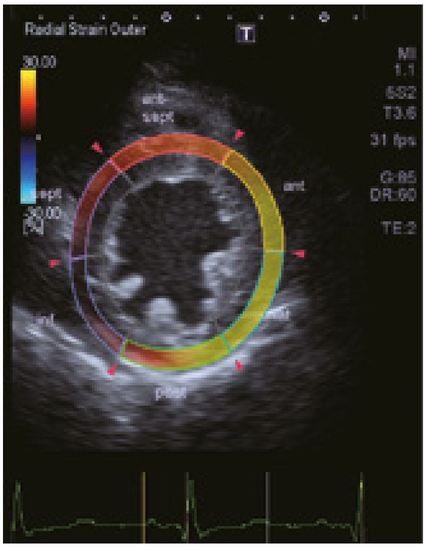
Individual strain analysis of the inner and outer myocardial layer provides specific information about the myocardial motion and thickening for each of the layers.

This unique function can help to diagnose the early stage of ischemic disease, because the inner layer will show reduced performance earlier than the outer layer, even though the total strain value is still within the normal range.

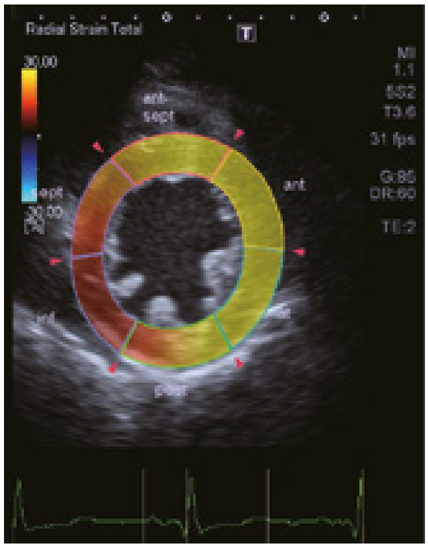
** Three images demonstrating a normal case where the strain value in the inner layer is higher than that in the outer layer.*



Inner Radial Strain



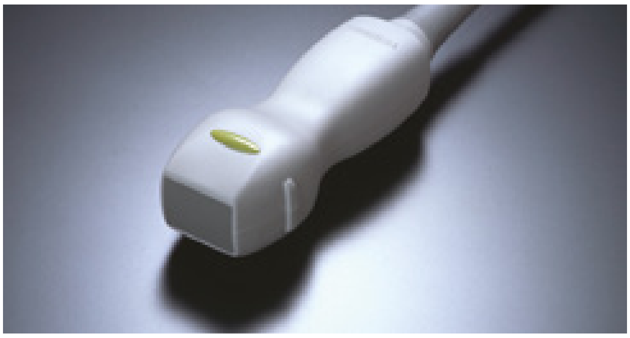
Outer Radial Strain



Total Radial Strain

Transducers that broaden clinical capabilities

Wall Motion Tracking is available on a wide range of sector and TEE probes.

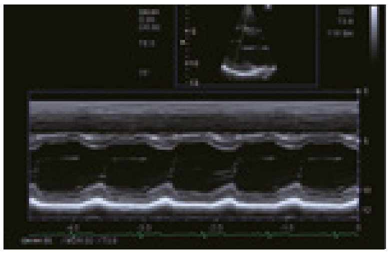


PSU-30BT

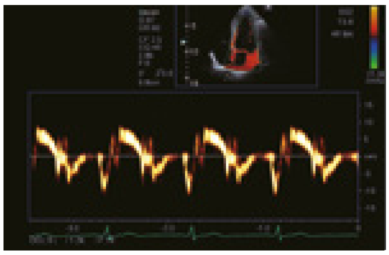
PET-512MD

Other cardiac applications on Xario 200

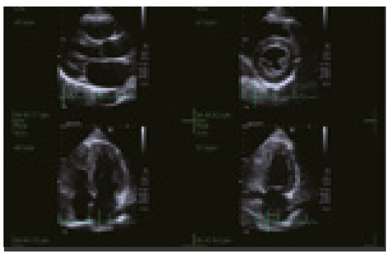
Xario 200 Platinum Series offers a complete cardiology package to ensure optimum workflow in your department.



Flex M



TDI



Stress Echo

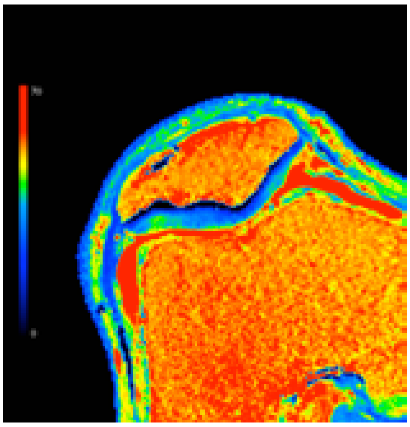
M-Power - Zen Edition Features

With the introduction of M-Power version 4.0 (Zen Edition), a rich set of new sequences, functionalities and options have become available for the Vantage Galan™ 3T, Vantage Titan™ 3T*, Vantage Titan™ 1.5T and the Vantage Elan™.

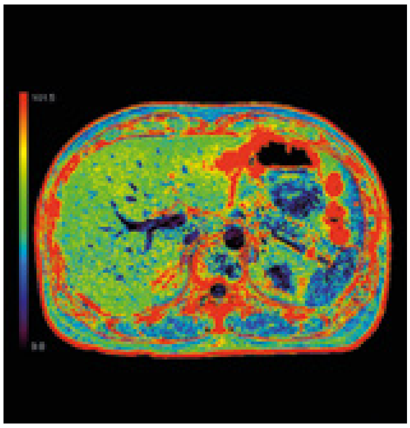
T2 and T2* Mapping Using mEcho FSE and FE

Using 2D Fast Spin Echo sequences allows for T2-map calculation for i.e. cartilage mapping in MSK. Maps of other anatomical areas are available as well.

2D Gradient Echo sequences are used to generate T2* and R2* maps to analyze Iron quantification in the liver.



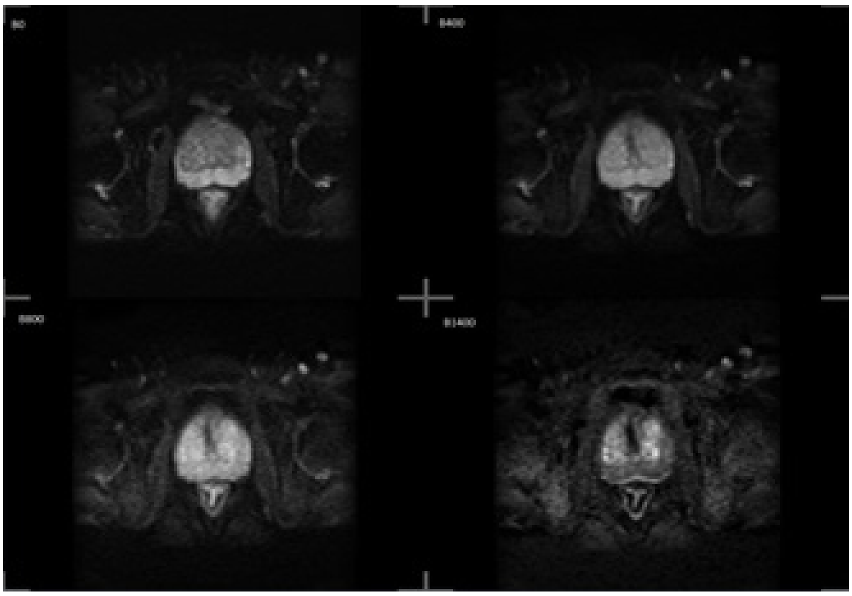
Fusion with colored T2 map image



R2 Calculation Result*

Multi-B - Using up to 15 B-Values in One Sequence

With the Multi-b Diffusion sequence up to 15 b-values, ranging from 1 - 10000, may be prescribed in one sequence.
Using post-processing other b-values may be calculated, (cDWI).

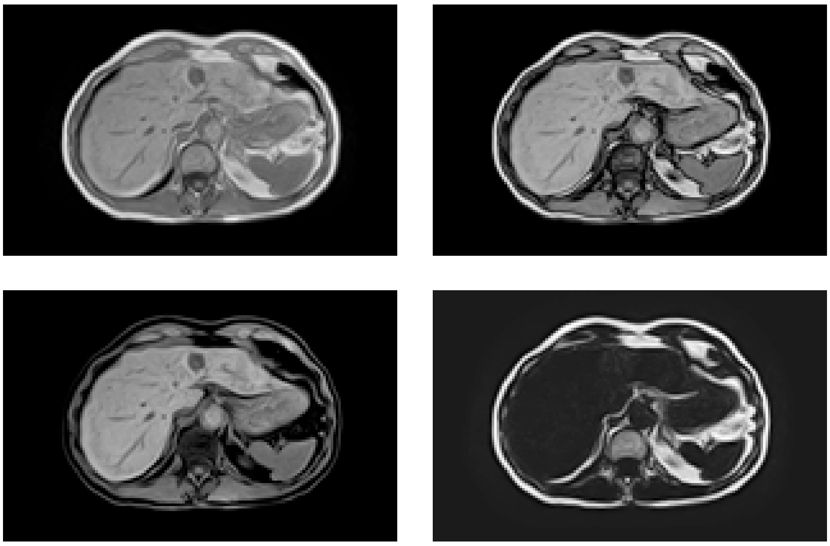


* *Available for the Vantage Titan 3T with Saturn Gradient*

DIXON (Water Fat Separation)

With the Dixon technique four image contrasts are generated: Water only, Fat only, In-Phase and Out-Of Phase images.

These images can be used, for example, to perform Fat Quantification (using Olea software).
Furthermore, excellent high resolution Fat suppressed images, without the need for an additional RF pulse (increased SAR),can be achieved.

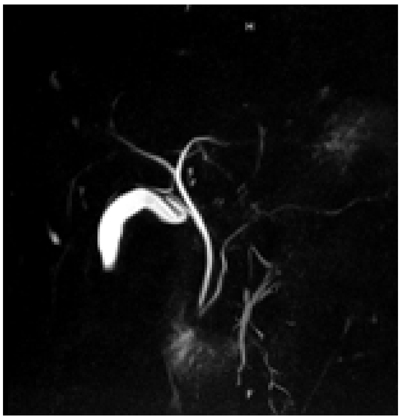


Abdomen Free Breathing

Abdominal scanning without breath hold commands.

Using the Free Breathing Technique in abdominal imaging reduces the stress and burden of breath hold scanning for the patient, yielding images with excellent image quality.

Patient set up does not require additional gating devices and bellows.

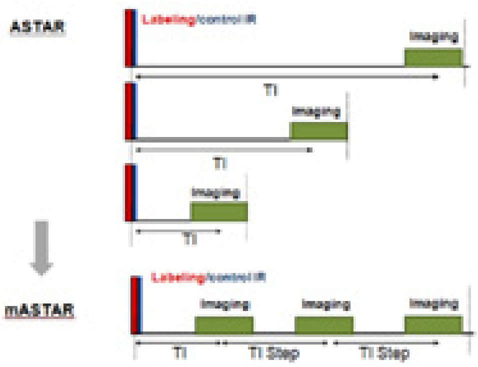


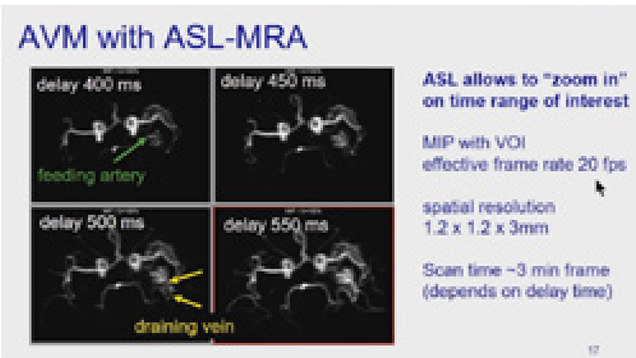
MRCP: Free breathing
Scan time: 2:55

mASTAR

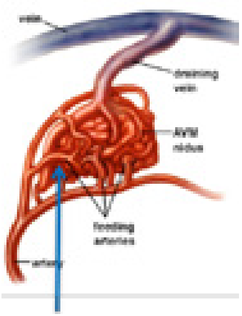
mASTAR is an Arterial Spin Labeling technique using the ASTAR method.
It can be used to obtain 4D non-contrast MR Angiography images in order to visualize i.e. Arterio Venous Malformations (AVM).

mASTAR reduces scan time vs. normal ASTAR.
It can acquire 7 time frames in one sequence in 5 min. 10 sec.





Courtesy of VU University Medical Center Amsterdam



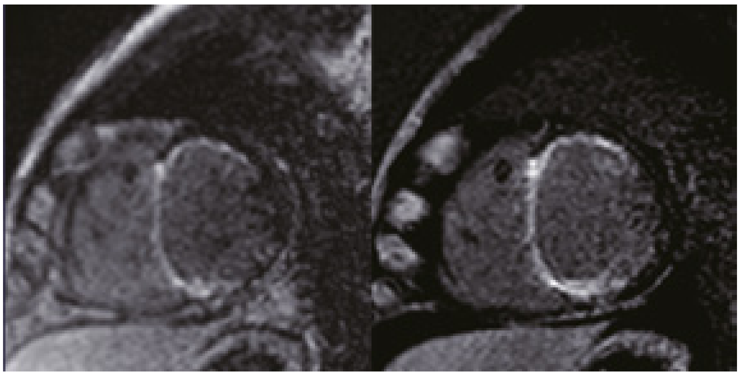
Stereotactic Radiation Surgery Target

M-Power - Zen Edition Cardiac Features

PSIR (Phase Sensitive Inversion Recovery)

PSIR in the heart provides improved contrast in late-enhanced imaging by using a more robust nulling of healthy myocardial Signal without the need for an inversion time (TI) calibration scan.

By eliminating the need for calibration, cardiac examinations can be completed with fewer breath holds and greater patient comfort.



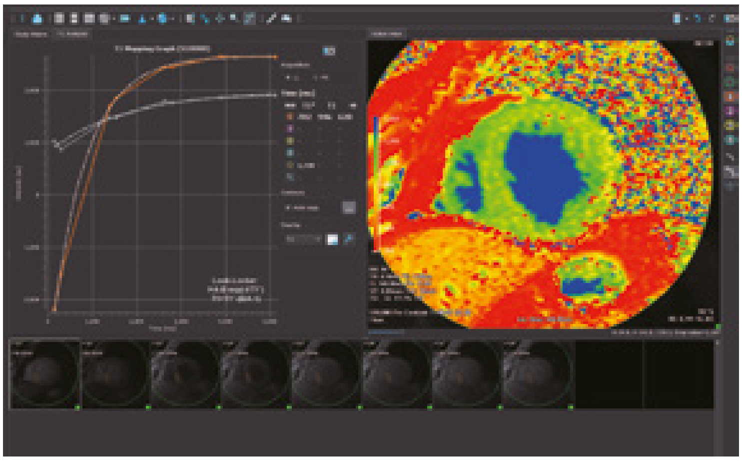
Delayed Enhancement *PSIR*

Courtesy of Instituto do Coração

MOLLI (MOdified Look-Locker Inversion recovery)

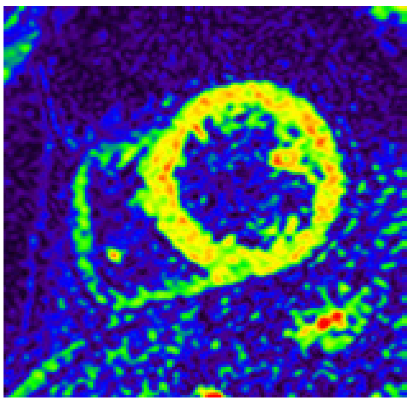
MOLLI sequence for Cardiac Imaging. Expand your cardiac toolset with T1 mapping, allowing you to acquire a much more quantitative characterization of myocardial tissue.

Toshiba Medical's T1 mapping utilizes a MOLLI sequence, enabling the acquisition of a full T1 map within a single breath hold.



Post-processing on Medis software

Courtesy of Instituto do Coração



Colored Cardiac T1-map

M-Power - Zen Edition Optional Features

UTE (Ultrashort Echo Time) Lung and MSK Imaging Example

UTE acquires data in a radial pattern from the center of the k-space, immediately after the RF excitation pulse is applied. It enables the depiction of tissues with very short T2* values, such as the lung.

UTE, Lung tissue imaging example

Acquisition of tissue with short and longer TE → subtraction → UTE image.

Ultrashort TE

longer TE

Subtracted UTE image

EasyTech

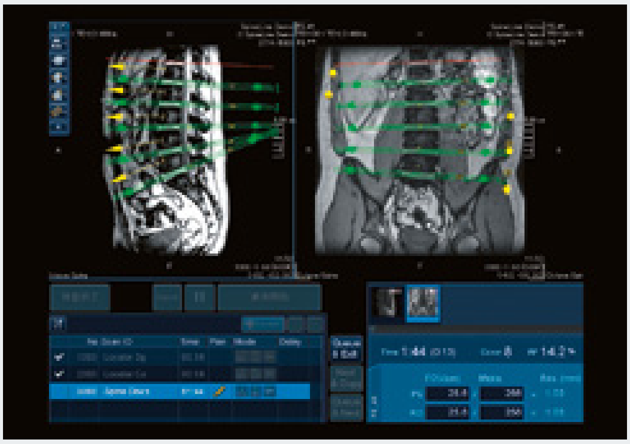
Improve workflow with a suite of auto alignment tools to guide the operator through the process from beginning to end. EasyTech offers automatic slice alignment and positioning for cardiac, neuro and spine exams.

SpineLine

With its auto-locator functionality, SpineLine allows you to plan spine studies quickly and easily. Sagittal and coronal locators allow you to set double-oblique slices, enhancing the reproducibility of follow-up exams.

NeuroLine+

Achieve outstanding scan consistency for all your brain exams with NeuroLine+. The function's intelligent alignment algorithm allows you to automatically set up according to AC-PC and OM line.



SpineLine

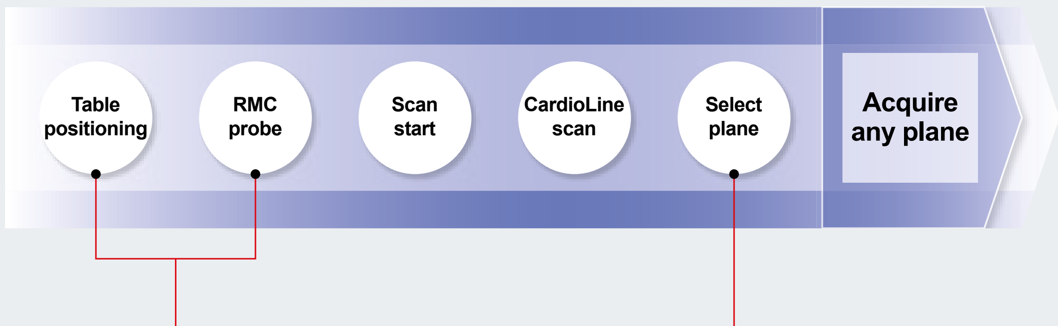
NeuroLine+

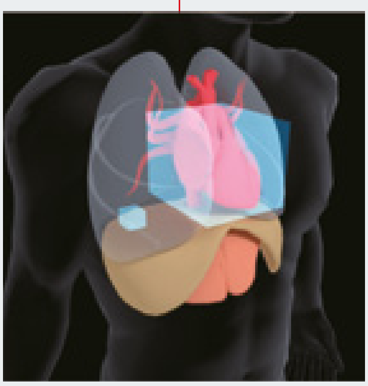
SUREVOI™ Cardiac

Automatic detection of heart and liver with a non-rigid model allows for full workow automation from table positioning to the Real-time Motion Correction (RMC), probe placement and fully automated cardiac planning.

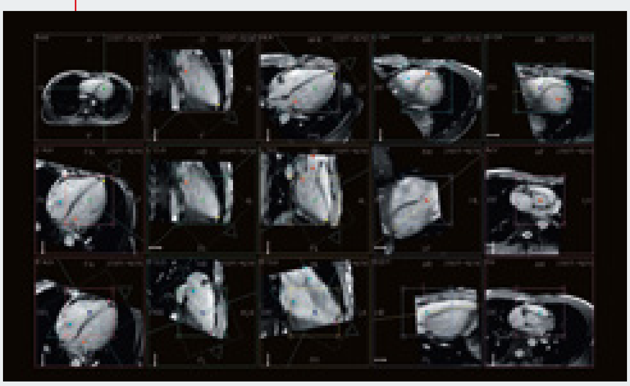
CardioLine+

CardioLine+ automatically identies the 14 standard cardiac planes including right and left ventricle, as well as the four cardiac valves in a single breath-hold scan.





SUREVOI Cardiac



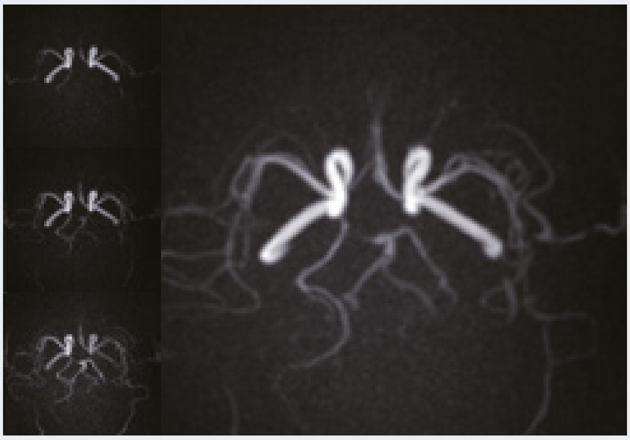
CardioLine+

Pianissimo Zen

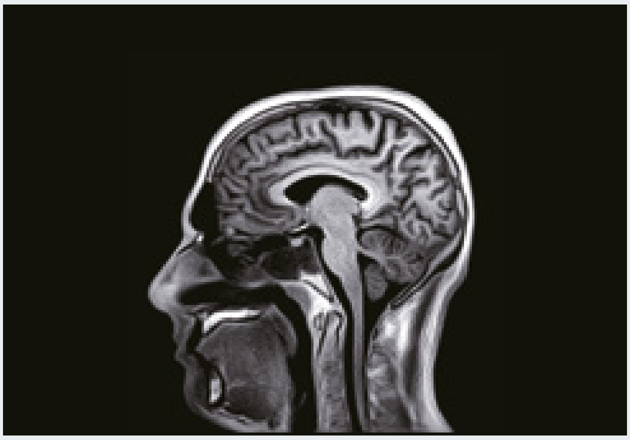
MR acoustic noise is one of the major complaints of patients and medical sta. Toshiba Medical's patented Pianissimo acoustic shielding technology signicantly reduces the noise in and around the MRI environment for every sequence, every scan and every patient.

Pianissimo Zen quiet sequences further reduce noise to just above ambient noise level, making exams even more comfortable and easier to complete.

[1] *mUTE : minimized acoustic noise utilizing UTE*



mUTE[1] / mUTE 4D-MRA



mUTE[1] 3D T1

MR Theater 1*

Zen Edition offers an immersive in-bore MR Theater option. As the images displayed appear to be much farther away than the actual bore, the MR Theater provides a uniquely comfortable experience, encouraging patients to relax and stay still during the MR exam.

* *Optional for Vantage Galan 3T and Vantage Titan 1.5T*

Some features presented in this article may not be commercially available on all systems shown or may require the purchase of additional options. Please contact your local Toshiba Medical representative for details.

From left to right

Prof. Eric de Kerviler
Head of the Radiology Department

Aurélien Delmelle
Radiographer

Céline Rodriguez
Radiographer

Cyprien Ferrier
Radiographer

Dany Houillon
Radiographer

Infinix-i 4D CT Supports Pioneering Interventional Radiology in France

The Saint Louis Hospital in Paris, France, part of the city's public hospital system (Assistance Publique – Hôpitaux de Paris - AP-HP), is emerging as a global center of excellence in oncology. With a new Infinix™-i 4D CT system from Toshiba Medical, it is pioneering new interventional radiology techniques. Mrs. Eve Parier, General Manager of the hospital and Prof. Eric de Kerviler, Head of Interventional Radiology, explain how the new system supports progress in interventional radiology and oncology.

Saint Louis Hospital is recognized as a leading cancer center in France worldwide. It has developed expertise in the treatment of patients with breast-, skin-, colorectal-, and urinary tract cancers in particular.

"Our three main missions are care, research and teaching. We are dedicated to further developing complete care for patients and strengthening our expertise in oncology," Mrs. Parier remarked. "Our challenge is to support our experts and provide the best services possible for the patient. In radiology, the main development focus is on advancing interventional radiology. We have been committed to this field for several years."

New facilities

To advance its interventional radiology capabilities, the radiology team recently redesigned and renewed their radiology suite.

"We had to renew two CT scanners in the department, one of which was mostly dedicated to interventional radiology," said Prof. De Kerviler. "I initially considered installing a new, regular CT, leaving some room between the patient table and the gantry, and to use an additional mobile C-arm – A hybrid solution. At the time, I was convinced that this was the optimal solution. However, at the CIRSE (Cardiovascular and Interventional Radiological Society of Europe) congress in Lisbon, Portugal, back in 2015, I became aware of Toshiba Medical's Infinix-i 4D CT, and realized that this was exactly what I needed."

First impressions

impressed by the Infinix-i 4D CT, Prof. De Kerviler wanted to know more about how the new system performed in clinical practice. "Initially, I was not entirely convinced that it was a good idea to put two imaging assets - an angiosuite and CT - in the same room. It was difficult to imagine how to move from modality one to another and to see how flexible the system could be," he said. "However, I had the opportunity to visit some facilities in Japan already using the system, including the Shizuoka Cancer Center, an oncology facility in the Shizuoka

"It takes less than one minute to move from the CT system to the C-arm, and vice versa."

Prefecture and the Saitama Jichi University Hospital, a research hospital serving the Saitama Prefecture, which was an outstanding experience. It was great to see the teams in action. Of course, they were well-trained, but I could see how easily they could place a catheter using the C-arm, carry out a CT scan with the catheter in place, and move back to the C-arm: it was really great, very impressive, flawless: the Infinix -i 4D CT seemed very easy to work with."

Flexible & compact

Compared with other systems, the Infinix-i 4D CT offers the possibility to move automatically from one modality to the other.

"I was absolutely astonished by the outstanding image quality obtained with the C-arm in fluoroscopy. The system provides a very good trade-off between dose and image quality. It takes less than one minute to move from the CT system to the C-arm, and vice versa," he remarked. "I was also impressed by the width of the bore of CT system that I saw during my visit to Japan. For interventional procedures, free-movement of instruments within the gantry is very important. It is best if we can place the needle and re-orientate it without having to moving the patient in- and out of the scanner. With the large bore of the Infinix-i 4D CT, we can carry out all procedures easily inside the gantry. That's what's great about the system. It is very convenient for all interventional radiology procedures."

Compact enough for small imaging rooms, the Infinix-i 4D CT is a flexible option that can support a wide range of interventional radiology settings and procedures.

"When you see the scanner in a picture, you might think that you need a very big room to accommodate it, but it is not the case. While our scanning room here at the hospital is quite spacious, I think the average interventional room in Japan is smaller - every square meter of space is very expensive in Japan," Prof. De Kerviler continued. "So, for many medical centers with limited space, it is very reassuring that the system can fit completely in quite a smaller room. However, I knew that in our new radiology room, we would still have plenty of room alongside the new system for TACE (transarterial chemo-embolization) guidance systems, resuscitation equipment and everything required for the anesthesiologist. This was quite a plus point."

Groundbreaking research

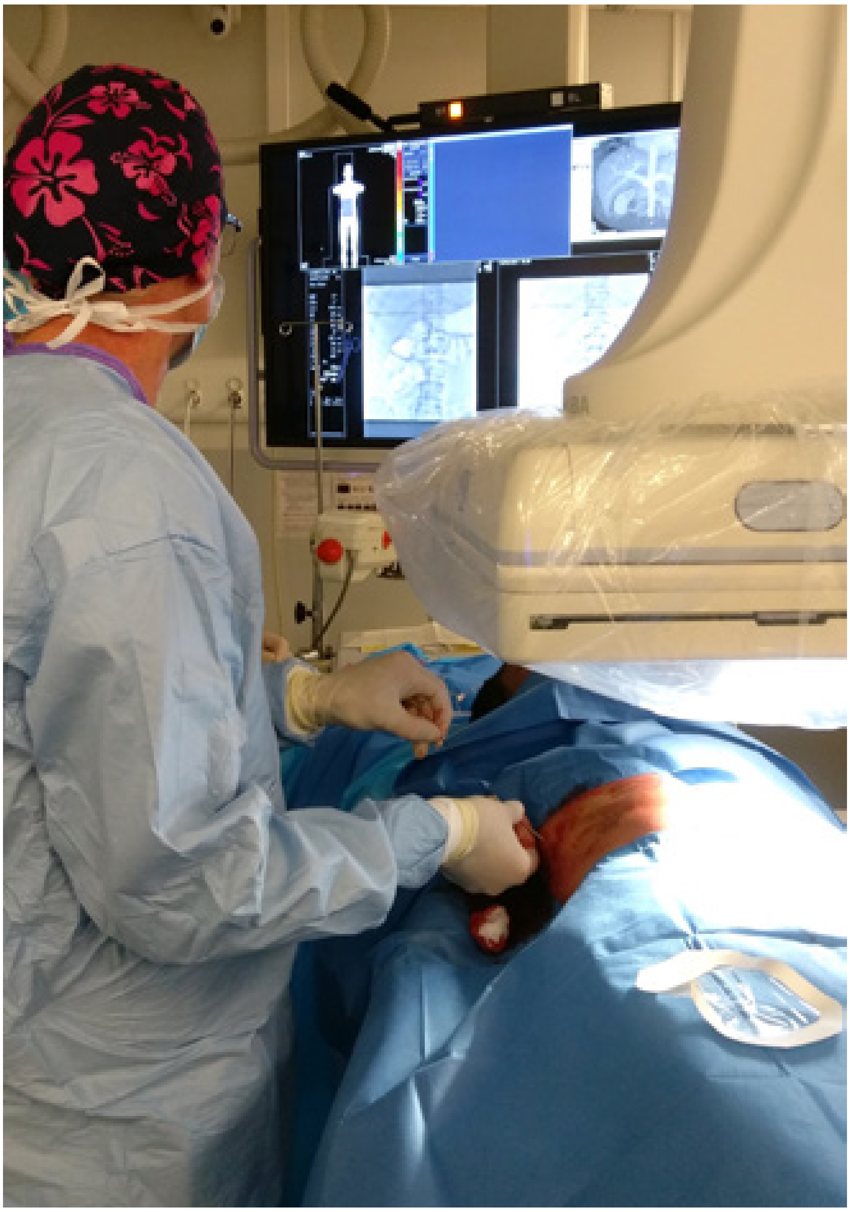
The new Infinix-i 4D CT system from Toshiba Medical, installed at the beginning of this year, contributes to the team's efforts to extend the boundaries of interventional radiology. Most recently they have pioneered a new technique in the treatment of liver- and pancreatic conditions.

Mrs. Eve Parier

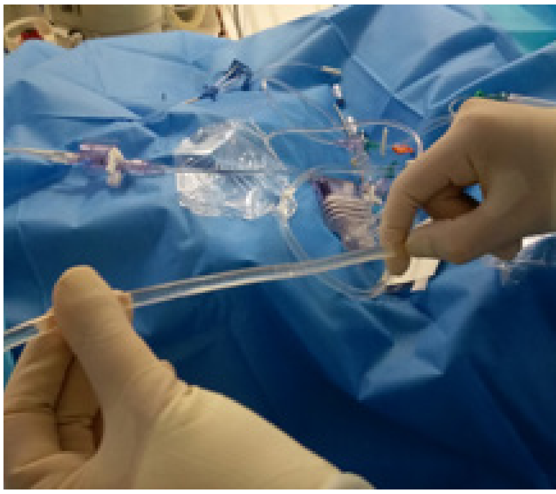
Mrs. Eve Parier has worked in hospital management for more than 20 years. She is the General Manager of the Saint Louis Hospital and the CEO of three hospitals in the Paris public hospital system (Assistance Publique – Hôpitaux de Paris - AP-HP).

Prof. Eric de Kerviler

Prof. Eric de Kerviler has more than 20 years experience in radiology. He studied and trained in Medicine, Nuclear Medicine and Radiology at the University of Paris, France and worked for most of his career in the Saint Louis Hospital. He is now the Head of the Radiology Department and specializes in interventional radiology and tumor research.



Islet cell transplantation technique
The islet cell transplantation technique for Type 1 diabetes treatment involves several steps. Firstly, the pancreas of a deceased organ donor is excised by surgeons. Then, the islets cells of this pancreas are isolated and processed. Lastly, purified the islet cells are infused through a catheter placed into the portal vein of the recipient patient by the interventional radiologist. The procedure is carried out under local anesthesia and is completed in around one hour.



"Islet cell transplantation is a very smart technique that involves injecting a suspension of islet cells within the hepatic portal vein of a recipient and then grafting the islet cells in the liver. Subsequently, the liver of the recipient will be able to secrete insulin by itself. This is very useful in patients with refractory diabetes, who have a lot of resistance to insulin," Prof. De Kerviler explained. "It's a very promising technique that we began working with a few years ago, but until now, the procedure was carried out in the operating room by catheterizing the mesenteric vein section of the hepatic portal vein. Now, we are able to perform this technique in our new interventional radiology suite using the Infinix-i 4D CT in one hour. We carried out our first successful islet cell transplantation on this system very recently."

Development partnership

Another reason that lead to his decision to opt for the Infinix-i 4D CT was Toshiba Medical's collaboration program.

"Following my trip to Japan, I felt that Toshiba Medical had a strong will to collaborate with us and offered real partnership in development," he said.

The visit inspired Prof. De Kerviler to think of further applications for the system.

"My only concern at the time, was that while we already carry out quite a range of interventional procedures here one of the most important diseases in Japan is hepatocellular carcinoma, or HCC, which is not currently our major focus," he said.

"This made me think about how I could use the new tool for other procedures in other organ systems: for example, urinary- or ablation procedures."

With these experiences in mind, Prof. De Kerviler changed his plans for the new interventional radiology suite.

We started another story. Investing in an Infinix-i 4D CT is different to investing in a regular CT system," he remarked. "The framework of the collaboration with Toshiba Medical provided a good deal, and my colleagues also became convinced of the potential benefits of investing in the Infinix-i 4D CT. We started with a 'blank sheet of paper', so to speak - we were able to completely designed a new room especially for the CT.

"The Infinix-i 4D CT and collaboration with Toshiba Medical have contributed towards enabling us to meet the growing challenges in oncology."

This is always easier than fitting equipment into an existing room. We designed our new imaging suite to our exact needs in direct collaboration with Toshiba Medical. We were able to create an environment very similar to that of an operating room – sterile, with different pressure between rooms to ensure renewal of the air. We worked closely with Toshiba Medical, starting directly at the shipping of the equipment from Japan, which was exactly on time. The installation was completed without any delays - We started on the exact day that we agreed upon."

"We were impressed with the efficient installation of the Infinix-i 4D CT system and the medical team is very pleased and satisfied with the system," Mrs. Parier remarked. "So far, training of the technicians and the radiologists has gone very well and the continued support of the Toshiba Medical team has been outstanding.

Integrated into clinical practice and research

The radiology team and clinicians initially found the new system a bit more complex than a regular CT to use, but they quickly became confident in using it. The system is in use for a variety of procedures, such as biopsies, tumor ablation, drainage and nephrostomies. For procedures, such as spiral requisition and cryoablation in particular, the Infinix-i 4D CT offers the advantage that the system can be maneuvered without interfering with the equipment required.

“Everyone is now happy very pleased to work with the Infinix-i 4D CT and can see the potential of it,” remarked Prof. De Kerviler. “With our previous system, we were focused on CT procedures. The Infinix-i 4D CT has opened up a new field of possibilities in fluoroscopy. Following installation, we have steadily increased the number of fluoroscopy-guided procedures. With this, we are able to treat new indications and develop and use new procedures. We anticipate moving towards performing an equal number of CT- and fluoroscopy-guided procedures, and in some cases, we may be able to combine both techniques. With this new clinical concept, we are now convinced that we will be able to push the boundaries of interventional radiology, and develop and perfect more involved techniques, such as fluoroscopy-guided placement of PEG LINES and gastrostomies.”

With the success of the recent islet cell transplantation technique, the next focus for the interventional radiologists at Saint Louis Hospital is to use the Infinix-i 4D CT to advance the treatment of metastatic liver cancer.

“While we have few patients with HCC - a primary liver cancer - we often have to treat patients with metastatic liver cancers, because of the tendency of other types of cancers, including breast-, and colorectal cancer and malignant melanoma, to spread to the liver,” Prof. De Kerviler said. “We are hoping to increase the number of treatment options for the treatment of metastatic liver cancer by testing new clinical applications using the Infinix-i 4D CT. If patients have solitary metastases, we can ablate the tumor. When the patient has several metastases, we plan to develop techniques to place a catheter in the hepatic artery and inject chemotherapy-agent directly into the liver through this. In case, we will need to change the anatomy of the liver, because sometimes we want to expand one side of the liver and decrease the other side of the liver, we should be able to embolize the portal vein or some segments of the portal vein, we hope to achieve this in the next six months.”

Growing challenges

In addition to developing pioneering new interventional radiology techniques, Saint Louis Hospital, of course, faces the same challenges as other medical facilities: growing demand for interventional procedures, increasing complexity of interventional procedures and pressures to treat patients sooner.

“Despite the fact that our radiology team grows annually with the addition of approximately six interventional radiologists, we face challenges not only in terms of number of interventional procedures required, but also in terms of increased complexity of procedure. This means that for some procedures the average time that is needed is higher,” explained Mrs. Parier. “Our team still have to push boundaries and to extend their working hours to be able to cure and to manage the patient within a reasonable amount of time. In addition, as life generally speeds up, we must be able to react faster, in the best interests of the cancer patient too. The Infinix-i 4D CT and collaboration with Toshiba Medical have contributed towards enabling us to meet the growing challenges in oncology. It is a good partnership and I think it is a good investment for the Radiology Department and for the Saint Louis Hospital.” //

Preliminary Experience of Ultra-High Frequency Imaging with the Aplio i-series

Professor Adrian K.P. Lim

The advancing technological improvements of high frequency linear transducers offers significant clinical benefits for ultrasound operators where the anatomical structures and hemodynamics of minute vessels can be delineated with unprece-dented clarity and definition. These advances in high frequency transducers are of particular benefit where very high resolution is paramount. For example, in musculoskeletal (MSK) and peripheral nerve imaging, small parts (salivary and thyroid glands), as well as soft tissue "lumps and bumps" dermatologically. The detailed information of the surrounding vasculature can also be of significant diagnostic benefit.

Incorporating the innovative iBeam forming technology, front-end Intelligent Dynamic Micro-Slice technology (iDMS) and latest transducer components, two new high frequency linear transducers have been developed for the Aplio™ i-series. These technologies produce sharper, finer and a more uniform ultrasound beam. The grey scale images have enhanced resolution and penetration while the Doppler sensitivity is improved especially with Superb Micro-vascular Imaging (SMI) enabling depiction of neovascularity not possible with conventional Colour/Power Doppler.

The ultra-wideband high frequency linear transducer covers the frequency range normally provided by two previous conventional linear transducers (1005BT & 1204BT) and provides optimum resolution and penetration in one transducer. This 2-in-1 transducer enables more effective transducer management.

The outstanding new development however, has to be the ultra-high frequency probe which utilises frequencies of up to 24MHz, previously unimaginable in clinical imaging. This new probe provides exquisite spatial resolution on both greyscale and Doppler imaging but with surprisingly sufficient penetration for it to be utilized in routine clinical scans. This elevated frequency range expands the horizon of clinical ultrasound allowing depiction of anatomy and diagnoses in structures not previously possible.

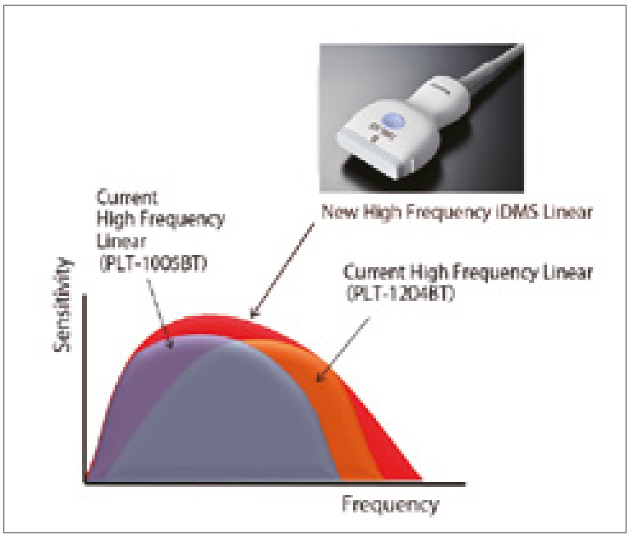


Figure 1. Ultra-wideband high frequency linear transducer

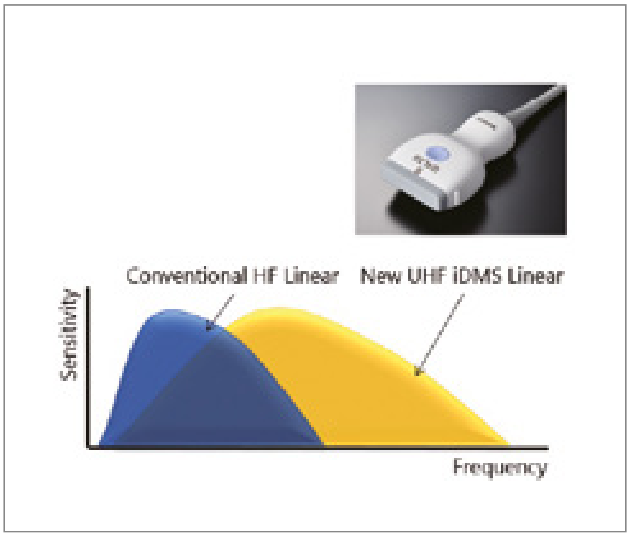


Figure 2. Ultra-high frequency linear transducer

CASE STUDIES

MSK

Case 1: Supraspinatus Tear

A former cricket player complained of ongoing shoulder pain. Using the i18LX5, a partial width, partial thickness, humeral surface supraspinatus tear was identified. However, with the i24LX5, the tissue structures and tear were delineated with greater detail and definition. The high resolution of the ultra-high frequency transducer allows greater diagnostic confidence obviating the need for further imaging and thus enabling appropriate treatment without delay.

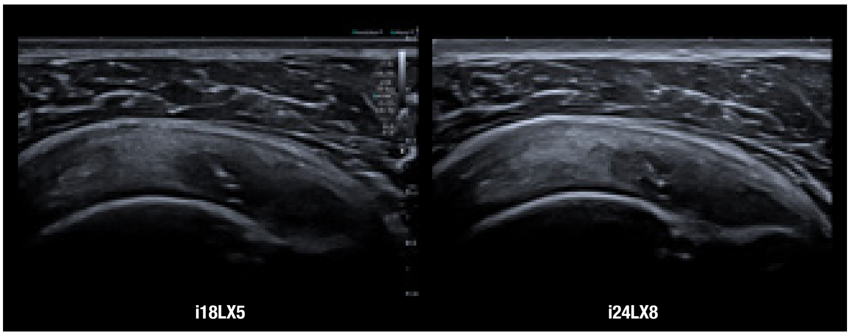


Figure 3.

Case 2: Supraspinatus Tendinosis and Subacromial Subdeltoid Bursitis

The i18LX5 shows detailed structures with good penetration for an operator to perform this routine examination rapidly with good diagnostic confidence. The i24LX8, shows significantly increased detail of tissues in the near field and with sufficient penetration through the whole supraspinatus tendon for it to be diagnostic clinically. These paired images demonstrate the capabilities of both the i18LX5 and particularly the adequate penetration of the ultra-high frequency transducer i24LX8 which allows it to be utilized in general MSK imaging.

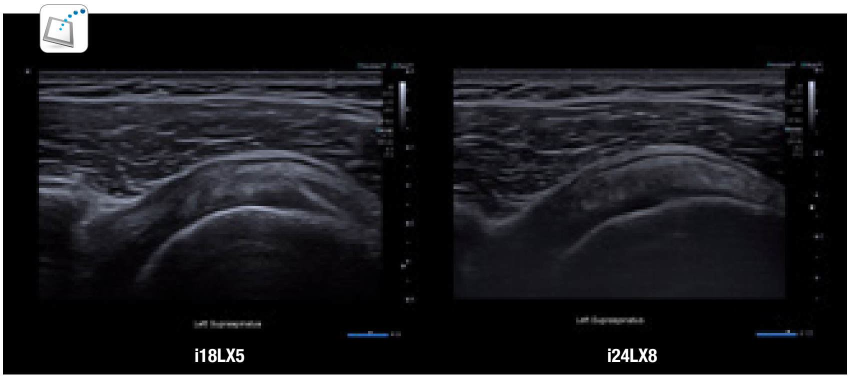


Figure 4.

Case 3: Rheumatoid Arthritis

This female patient with known rheumatoid arthritis complained of mild tenderness in the left metacarpophalangeal joint (MCPJ) of her index finger and was referred for an ultrasound scan of the joints in her hand to assess if there was any active synovitis. The detailed B mode of the i24LX8 probe shows a relatively normal joint with no synovial hypertrophy, effusion or erosions. However, vascular flow can be detected within the joint using SMI but not with Power Doppler (PD). Her other, non-symptomatic joints did not demonstrate any vascular flow with SMI or PD. Doppler Ultrasound is currently the gold standard for denoting active synovitis in small joints and together with state-of-art SMI technology may prove even more effective at early detection of active inflammation in patients with arthritides, thus enabling appropriate treatment without delay and further damage to these joints.

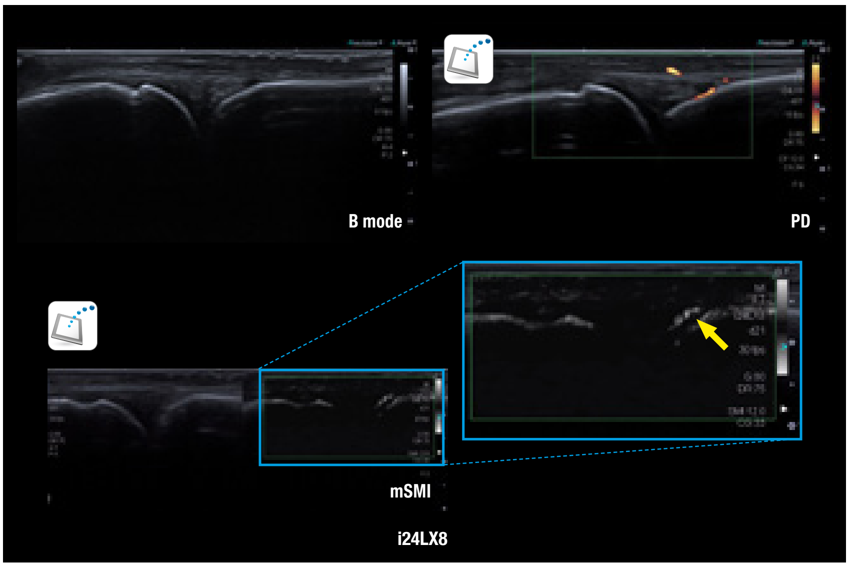


Figure 5.

Case 4: Mid-Substance Achilles Tendinopathy

Both Aplio i-series linear transducers show good detail of the thickened Achilles tendon and also depiction of the neovascularity confirming the diagnosis. However, utilizing the ultra-high frequency transducer, the subtle fusiform thickening and tendon structure is better delineated with higher detail although there is slight reduction in the Doppler signal.

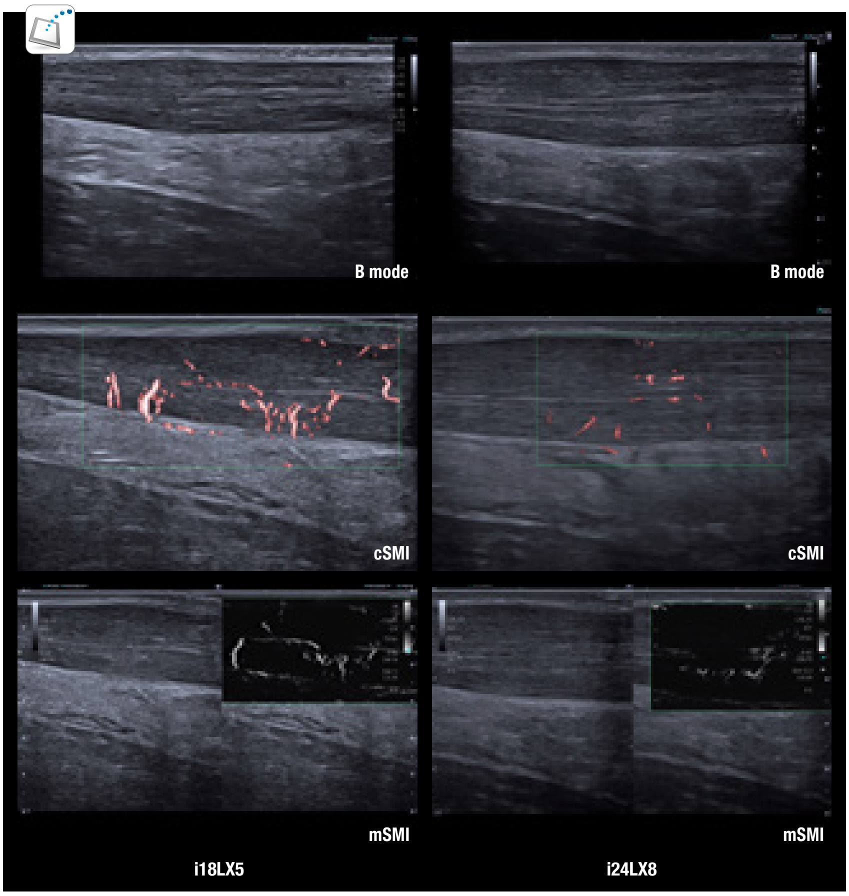
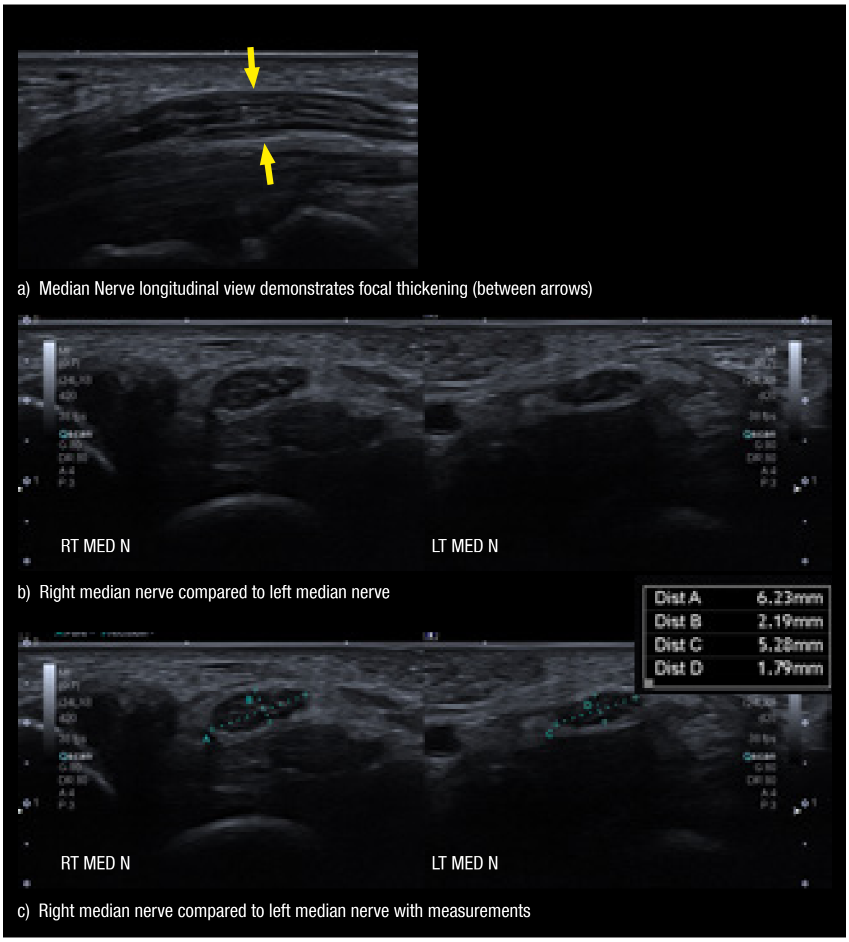


Figure 6.

Peripheral Nerves

Case 1: Median Nerve

This case demonstrates a thickened right median nerve compared with the left median nerve at the level of the flexor retinaculum compatible with a diagnosis of right carpal tunnel syndrome. Using the i24LX8, the ultra-high frequency allows depiction of the neurofibrillar structures in great detail and appreciation of the subtle focal thickening. The measurements highlight the difference between the two median nerves adding to the diagnostic confidence.



a) Median Nerve longitudinal view demonstrates focal thickening (between arrows)

b) Right median nerve compared to left median nerve

c) Right median nerve compared to left median nerve with measurements

Figure 7.

Thyroid

Case 1: Thyroid Nodules

These paired images are of a patient with hypothyroidism and multiple semicystic/solid nodules. Both Aplio i-series transducers outline the internal structures of the thyroid nodules well. However, with the i24LX8, the contour and border of the smaller nodule are sharper and there is no loss of penetration even working at this very high frequency. This greater clinical detail may aid diagnosis and better classification of thyroid nodules.

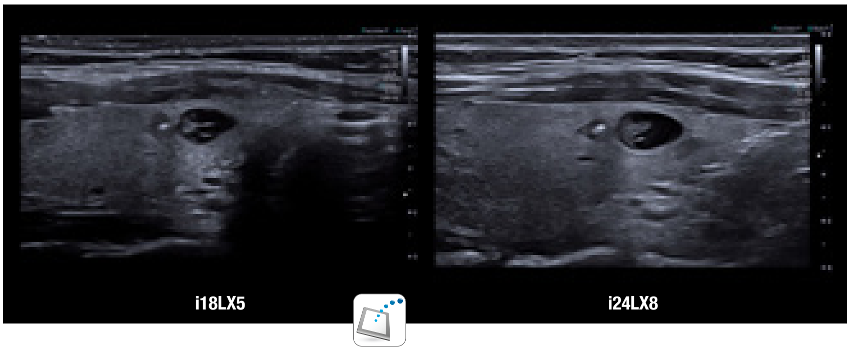


Figure 8.

Dermatology

Case 1: Small Sebaceous Cyst

Case 1a
This small palpable 3mm subcutaneous lesion can be easily detected using the i18LX5 probe. However, the subtle track leading to the skin can only be clearly delineated when scanning with the i24LX8 confirming a sebaceous cyst. These paired images again show off the ultra-high frequency probe which enables accurate diagnostic capability thus avoiding any doubt and avoiding any confirmatory intervention or follow up interval scans. Note the subtle echogenicity around this tiny cyst suggesting oedema and inflammation.

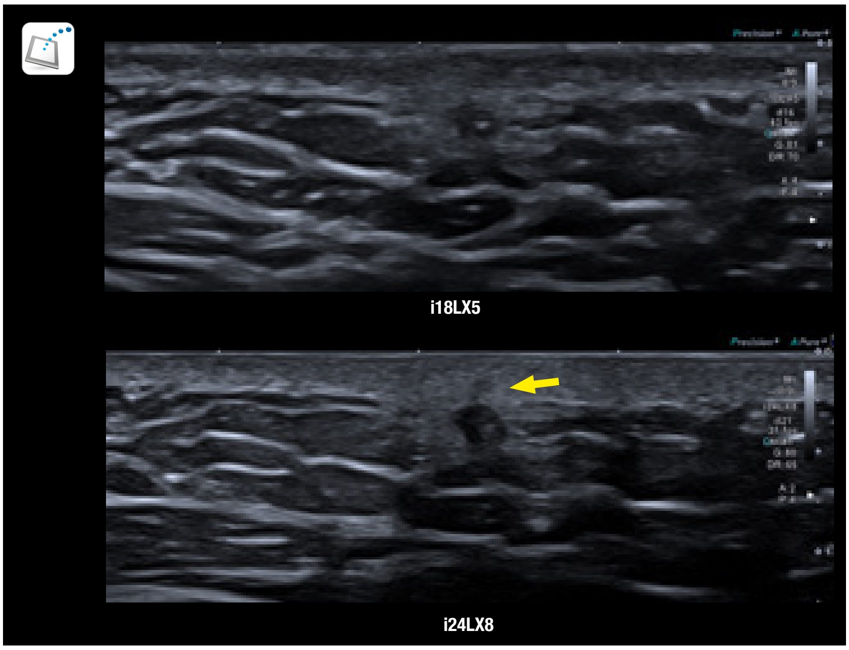


Figure 9.

Case 1b
This is a male patient with a sebaceous cyst where again the dermal track is shown on the i24LX8 only allowing an accurate and confident diagnosis thus obviating any further tests.

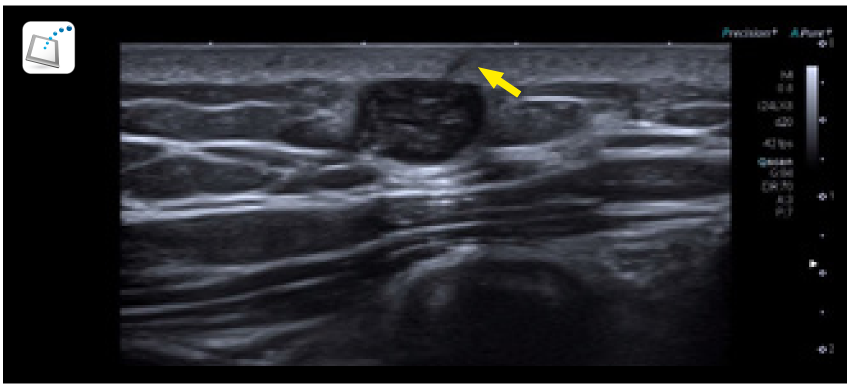


Figure 10.

Case 2: Infected Malignant Skin Ulcer

The unprecedented image quality of Doppler imaging on i24LX8 in the near field is demonstrated in this infected malignant skin ulcer. cSMI and mSMI denotes the extensive rich hypervascular network of capillaries with high resolution not appreciated with lower frequency.

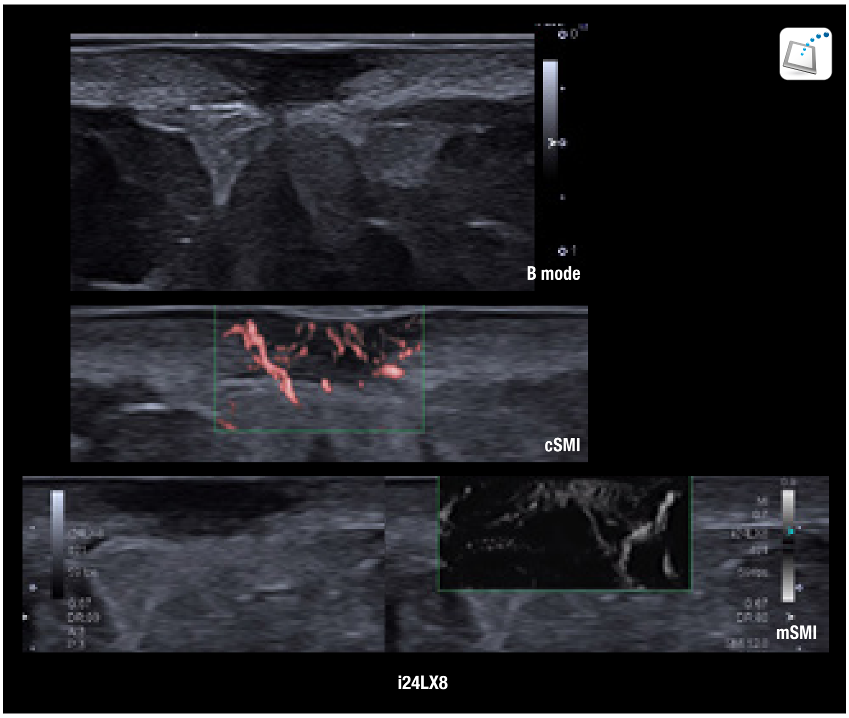


Figure 11.

Conclusion

The Aplio i-series is equipped with two extraordinary transducers, the ultra-wideband frequency linear transducer i18LX5 (a "2 in 1" probe) and the ultra-high frequency 24MHz linear transducer i24LX8. The Doppler sensitivity and grey scale resolution of both probes are extraordinary and significantly improved on previous technologies. The combination of these probes allows greater diagnostic confidence as anatomical structures and vascularity are delineated in very high detail. The high resolution images obtained in the near field without loss of penetration of the 24MHz transducer are unprecedented. This has opened up a new horizon of clinical applications which are currently under evaluation. //

Professor Adrian K.P. Lim
Imaging Department, Imperial College and Healthcare NHS Trust, London, United Kingdom

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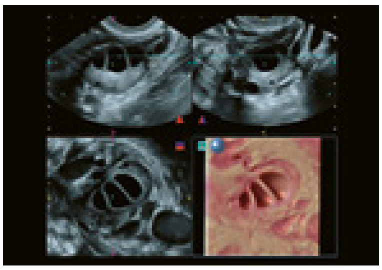

TOSHIBA MEDICAL SYSTEMS CORPORATION

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Dr. Bell
Interventional Radiologist

First Infinix-i Sky + in Europe

The Christie is an Oncology centre recently recognized as the UK's top specialist hospital. It offers comprehensive cancer care to patients from Greater Manchester and Cheshire (a catchment area that includes more than 44,000 people) with 26% of its patients referred from other areas of the UK. It is also globally renowned for its oncological research and is considered one of the world's most technologically advanced cancer centres. The Christie has opted to equip its new Integrated Procedures Unit with an Infinix™-i Sky + alongside a Ultimax™-i system, both from Toshiba Medical. With the new systems installed, The Christie's Interventional Oncology team can use advanced techniques to treat cancer. Dr. Jon Bell, Interventional Radiologist at The Christie, explained how this combination of state-of-the-art technology enables his team to push the boundaries of what they can do further.

"Interventional Oncology is a rapidly advancing speciality," said Dr. Bell. "It is the fourth pillar of cancer care and a massive growth area. There is a huge amount of interest and there is also lots of collaboration between different centres, data gathering and clinical trials. There are many Interventional Oncology meetings and growing attendance at both national and international meetings. Experts travel in from all over the world to share their expertise."

New Unit

The Christie's Integrated Procedures Unit (IPU) is a new facility that brings together five different teams: endoscopy, pain management, procedure team, plastic surgery and Interventional Radiology. It is a major investment towards advancing the hospital's capabilities in cutting-edge cancer treatment techniques.The creation of the £7.6m IPU has been made possible by part funding of £4.99m from The Christie charity. The project has helped to raise awareness of the value and further potential of Interventional Oncology.

"We strive to achieve the best outcomes for our patients. Obviously, we aim to achieve a cure if that is possible," added Dr. Bell. "We offer palliative and disease-modifying procedures. Functions that we take for granted such as swallowing can be restored to enable patients to eat and drink and at the other end of the spectrum, we can achieve a cure using techniques such as ablation. Treating such a diverse range of patients enables us to advance techniques even further. We see new problems emerging in patients returning to us, because they survive longer, as treatments deliver better initial outcomes, enabling us to work on overcoming new challenges with new Interventional Oncology treatment options."

Innovative Team

The team of Interventional Radiologists has recently increased from four to six. The Integrated Procedures Unit at The Christie is the first site in Europe to acquire an Infinix-i Sky + from Toshiba Medical.

"We consider ourselves to be Interventional Oncologists - a young group of enthusiastic consultants, who are very innovative and radiographic and nursing teams dedicated to pushing the service further," Dr. Bell continued. "We carry out a comprehensive range of vascular and non-vascular procedures and are embracing and developing new techniques in Interventional Radiology. Towards that, we need to work with state-of-the-art equipment. Before the team expanded, we shared a high volume of work between the four of us. We are very good at what we do, but we could be better with the right equipment. We want to use the latest technology, such as that provided by Toshiba Medical, and to reach our maximum potential."

"When I joined The Christie four years ago, our equipment had reached the end of its functional lifetime," he continued. "We are one of only ten centers in England performing radioembolization, which is

"I want to work with the best and for me the Infinix-i Sky + is the best on the market for Interventional Oncology."

a complex procedure, in addition to more routine intervention that would be commonplace in most university hospitals. We needed a more advanced technical system for our very advanced vascular work and a second multifunctional room to perform more routine procedures. The Infinix-i Sky + was included in our plan at the outset.

When I arrived, the idea was to procure the equipment later down the line. While we were focused on the whole concept of building the new unit - a big undertaking - I started the process to procure the systems that we wanted from an early stage, so that we could mould the rooms to best fit the systems and to ensure that they were optimally functional. I drove going out to tender at an earlier stage than originally planned – fitting equipment into existing spaces can be fine, but we were in the ideal position of being able to design the space the best way with Toshiba Medical on board. We've been fortunate to have the opportunity to establish the unit in this new building."

It was important to the team to acquire both high-end machines from the same company during the procurement process.

"The Ultimax-i has the functionality we need for doing routine work, as well as high-end Interventional Oncology work. We needed a system with multipurpose functionality to replace our older unit," Dr. Bell explained. "The Ultimax-i, which is probably Toshiba Medical's most popular system, fitted the bill. It was installed here about a month ago. It's a good work horse system producing good quality imaging, so it's similar to our old system, but obviously with seven years of technological advances. There are not many companies out there that can provide high end, multipurpose solutions -

Toshiba Medical is one of the few that can. Not only that, but they've given huge support over the last two years in terms of planning the lay-out of the rooms and listening to our needs as customers. Their innovation and involvement has been exceptional. We have built specific relationships with Toshiba Medical people whose enthusiastic engagement in the whole process has produced the perfect result. They have been brilliant in everything that they have done. Over the last few months, the engineers have been here on site, and that will continue going forwards. The commitment to aftercare and support that we've experienced has been excellent, because they want to make sure the image quality and the patient experience is the best that it can be."

First Clinical Procedures

While price is important to the team, they are most impressed by the quality and capabilities of the Infinix-i Sky +.

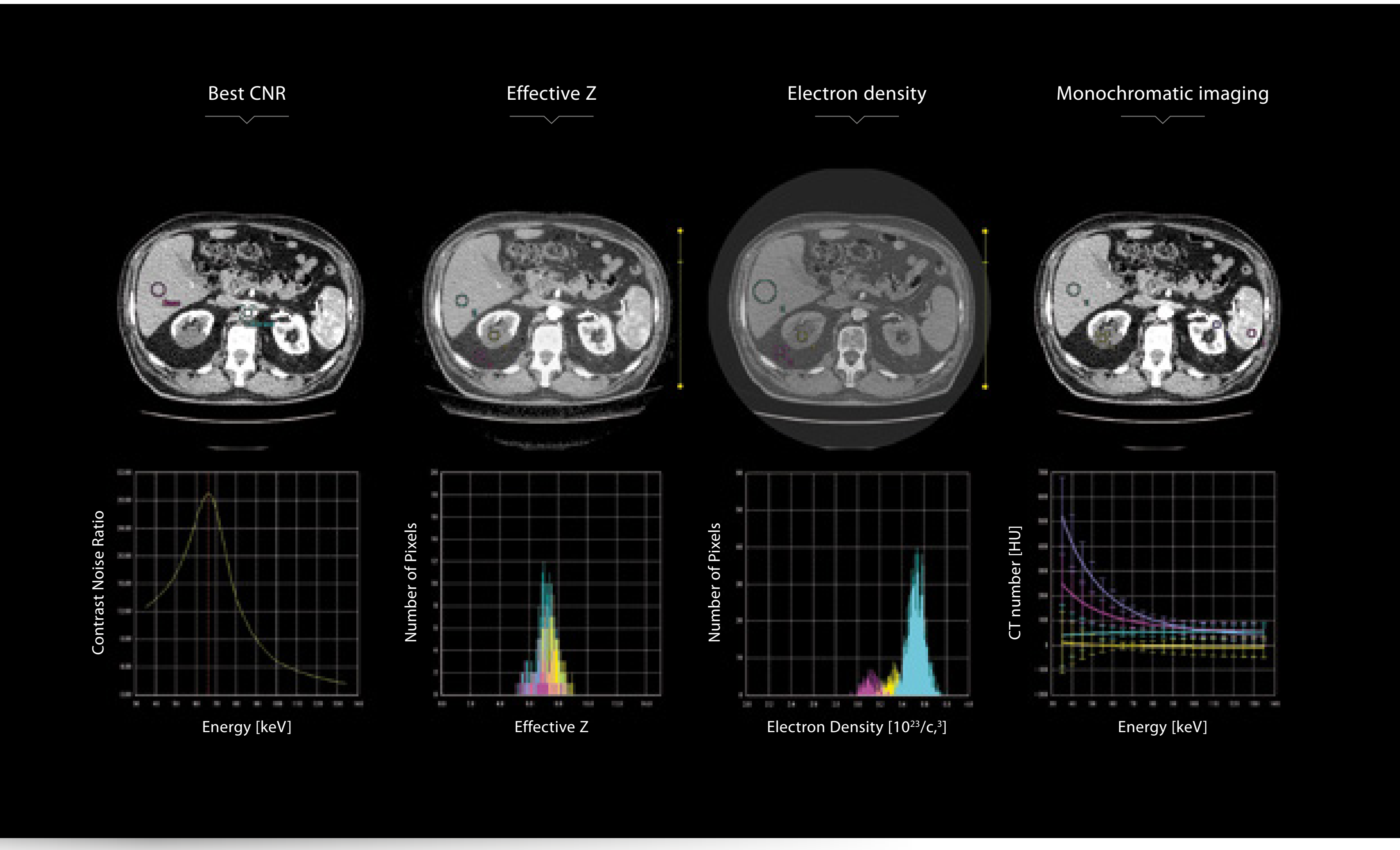
"It is really a pleasure to work in the new suite and it is great to see the whole team enthused by the new system. The Infinix-i Sky + is working extremely well for radial access and all the cases have been absolute success."

"The image quality is infinitely better. The monitor enables us to see the anatomy and our instruments with unparalled clarity. We've not had cone-beam CT before, although we've experienced it at different centres and heard other practitioners talking about it. There have been a few cases when we really would have found it useful, but now we have that facility and we can use that technological advancement to achieve better outcomes and to perform more intricate procedures such as prostate artery embolization."

"The crucial element is that the C-arm gives access to the limbs, and with this system, we can do that very easily," he continued. "We at The Christie recognize that there's a need for more educational opportunities in Interventional Oncology and we want to share our expertise. We felt that we were not in an ideal position to lead in this, but with these cutting-edge systems from Toshiba Medical, we can now contribute on a world stage."

"I want to work with the best and for me the Infinix-i Sky + is the best on the market for Interventional Oncology," he continued.

"The Infinix-i 4D CT from Toshiba Medical would be desirable for the future, and that is something that we will look at, having a positive experience with Toshiba Medical with this project. It would really help our ablation service, as that starts to grow. Sometimes we think less about price and want to be more focused on the best system, but actually, Toshiba Medical offered both the best price and performance. In their favor was also the strong, long-established relationship that we have with their sales and technical experts. In speaking to other centers and clinicians, they spoke positively about their experiences. Toshiba Medical have a big foothold in the UK market and this is growing as they lead the way with innovative technology. I am sure that our partnership will grow further and I'm proud of that with very high-end state of the art equipment, such as the Infinix-i Sky +, we can fulfil our goal to do our best for patients nationally and internationally. As a centre of excellence, in partnership with Toshiba Medical, we are able to push the boundaries of what we can achieve and there are no boundaries to what is possible." //



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Toshiba Medical's raw data based Dual Energy brings innovative and unique solutions to your clinical daily practice.

Characterize lesions with spectral curves for more accurate and non-invasive diagnosis, provide a more precise calculation for your radiotherapy treatment and differentiate intracerebral hemorrhage from iodinated contrast in patients that receive intravenous contrast material.

The raw data based Dual Energy acquisition allows for a wide range of cutting edge clinical applications to enhance your diagnosis and to further strengthen your daily clinical routine.

Paediatric cardiac imaging using Aquilion PRIME

Dr. Warin Fresse K, MD

In recent years advances in temporal and spatial resolution have allowed ECG-Gated cardiac CT to play a key role in the diagnosis of cardiac disease in paediatric patients.[1, 2] Trans-thoracic echocardiography remains the primary non-invasive imaging tool for demonstrating the functional and anatomical features of paediatric congenital heart disease. In cases of complex congenital cardiac anomalies CT completes ultrasound.

CT may provide accurate information to assess the complex spatial relationships of vascular airway compression which is frequently associated with congenital heart disease. Today, invasive cardiac catheterization is used for haemodynamic evaluation and percutaneous intervention. CT provides excellent anatomical detail of the cardiovascular system and any abnormalities necessary for pre-surgical planning. CT imaging is also useful for post procedure follow-up.

However, the increase in radiation exposure from CT in children has become a great concern. It is important to have CT protocols specifically designed for paediatric patients and to restrict CT use to specific cases where CT results are considered essential for patient management.

Protocol

In paediatric patients image acquisition remains challenging. In the University Hospital of Nantes, all pediatric cardiac CT scans are performed on a Toshiba Aquilion PRIME. Since its installation, we have performed around 140 cardiac CT scans between October 2015 and October 2016.

Newborns and infants are comfortably placed in a specially designed bed; we do not require any sedation prior to scanning, they simply drink their bottle. Teenagers and children older than 6 years of age are able to keep calm, and follow instructions provided by staff. However, for younger children, we occasionally require light sedation.

A biphasic injection of iodinated contrast (270 mgI/L) followed by a saline flush is injected using a power injector. The amount of iodinated contrast is based upon the weight of the patient and varies from 1.5 to 2 cc/kg. We do not use beta-blockers.

First, an AP and lateral scanogram of the chest is performed. These are used for both planning and dose modulation. We use the Wide-Volume Target CTA acquisition which is a dedicated scan mode for paediatric ECG-triggered scans. The Target CTA scan mode is designed to guarantee a low dose acquisition even in paediatric patients with a high heart rate (HR). A manual Exposure Window and target phase are selected prior to the scan.

In our clinical routine we set the target phase at 59% and Exposure Window to 350-400 ms which provides a reconstruction window from 30% to 80% of the R-R cycle in cases with high HR.

During the acquisition, a 0.5mm x 80 row volume is acquired every third beat: one beat for the acquisition the next two beats are necessary for table movement. Multiples volumes are acquired to cover the entire heart and automatic adaptive blending is used to stitch the scanned volumes into one reconstructed volume dataset. The scan mode allows significant dose reduction compared to helical scan mode3 (figure 1, table 1).

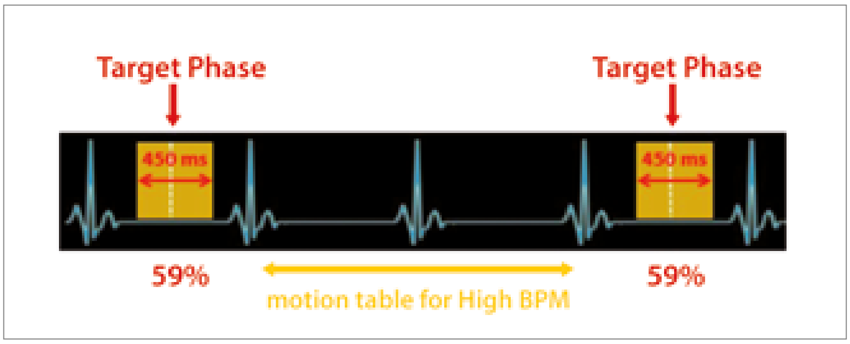


Figure 1: Acquisition technique

kv	80
mA	200
Collimation	0,5X 80
Exposure Window	350-400 ms
Target phase	59%
Rotation time	0.35 s
Pitch	-
Temporal resolution	175 ms
Slice thickness	0.5 mm

Table 1: Acquisition parameters

CLINICAL CASES

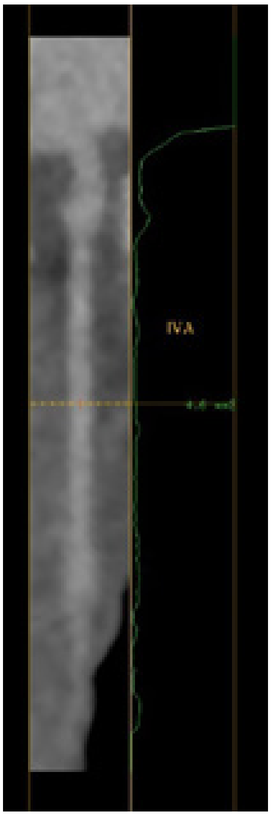
Case 1

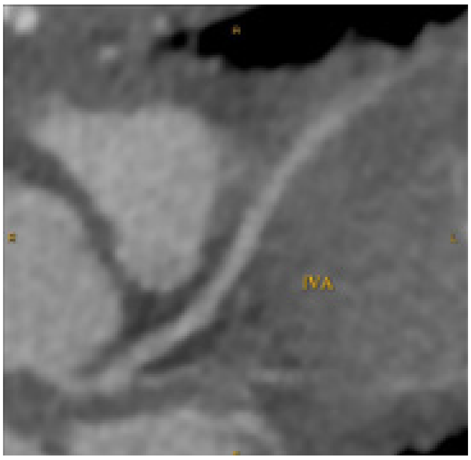
A child, 9 years old, was referred to CT scan for systematic coronary control after coronary surgery. She has a left coronary trunk atresia. It is a congenital coronary anomaly. A surgical coronary plasty was performed.

Heart Rate: 86 bpm
Contrast: 70 cc (320mgI/L), 20 cc saline.
DLP: 29.2 mGy.cm

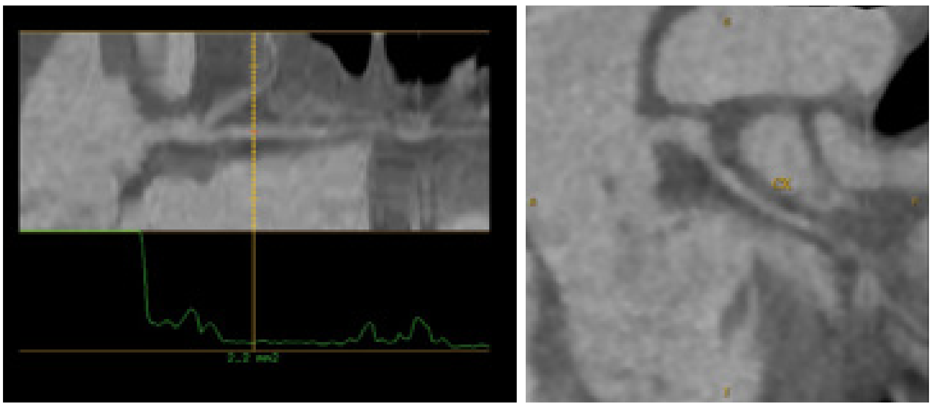
Axial MIP of the left main coronary artery following angioplasty.

The reconstruction of the coronary arteries demonstrate successful of surgical plasty.





Curved reconstruction of the left anterior descending coronary artery.

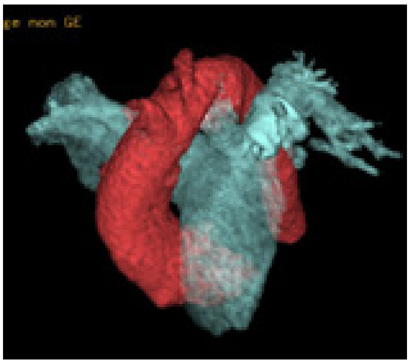


Curved reconstruction of the left circumflex artery.

Case 2

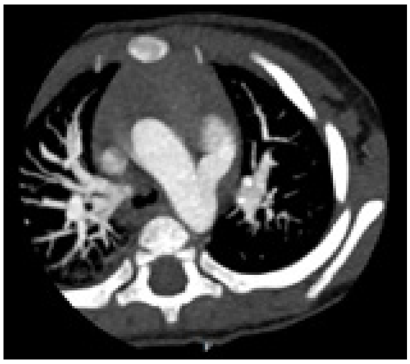
A 12 month old infant was referred to CT following percutaneous patent ductus arteriosus closure. Trans-thoracic echocardiography demonstrated the occluder protruding into the left pulmonary artery. The CT confirmed the migration of the occluder into the left pulmonary artery due to the large patent ductus arteriosus.

Heart Rate: 103 bpm
Contrast: 15 cc (270mgI/L), 7 cc saline.
DLP: 23.5 mGy.cm



Volume rendering reconstruction showing the large patent ductus arteriosus between the aortic isthmus (red) and the left pulmonary artery (blue). Unfortunately, because of the large patent ductus arteriosus, the occluder migrated in the left pulmonary artery.

Sagittal MIP reconstruction of the patent ductus arteriosus.

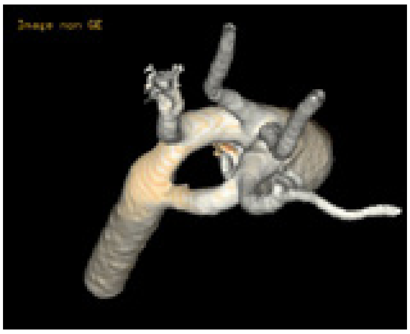


Axial MIP reconstruction of the patent ductus arteriosus.

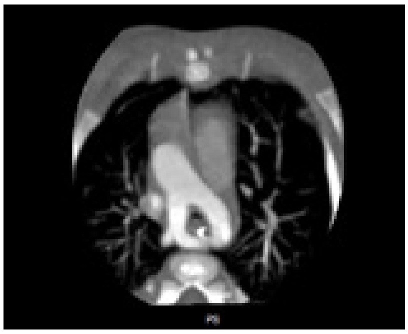
Case 3

A one month old infant was referred for a CT scan to visualize the aorta. The patient has had a stridor since birth. A double aortic arch was suspected. The CT allows assessment of the relationship between the aorta, trachea and oesophagus and a double aortic arch was confirmed.

Heart Rate: 132 bpm
Contrast: 7 cc (270mgI/L), 4 cc saline.
DLP: 22 mGy.cm



Volume rendering reconstruction showing the double arch. Right and left aorta are balanced.

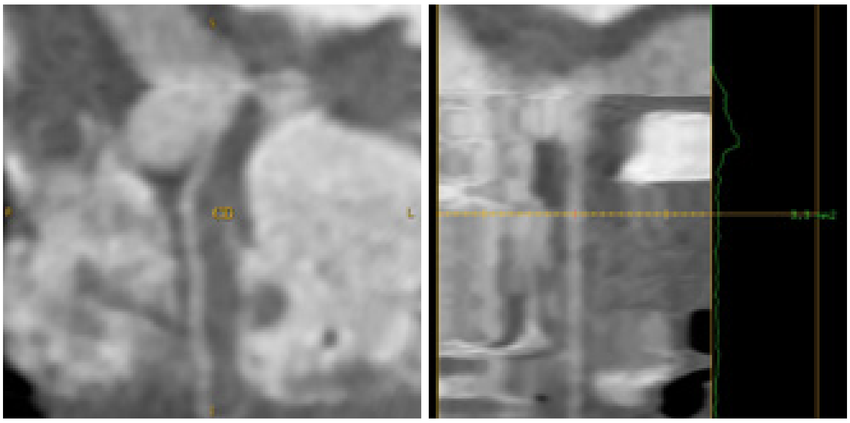


Axial MIP of the double aortic arch showing relationship between the aorta, trachea and oesophagus.

Case 4

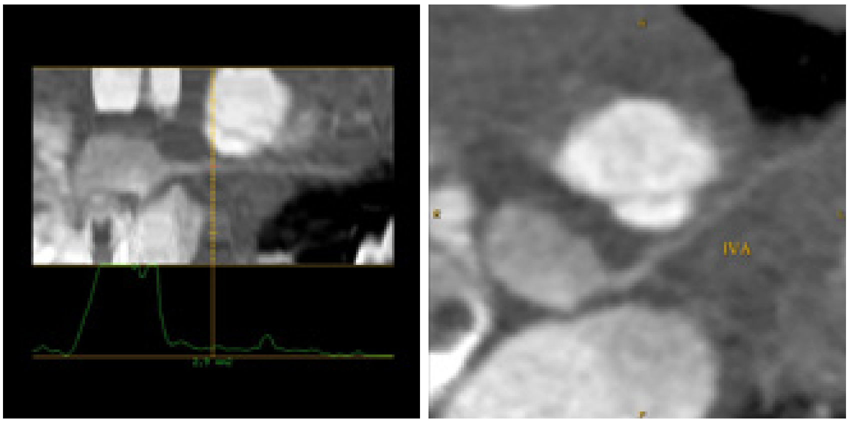
A 3 days old newborn presented with complex congenital cardiomyopathy with pulmonary stenosis and coarctation of the aorta. A CT was performed to visualize the origins of the coronary arteries prior to surgery.

Heart Rate: 150 bpm
Contrast: 6 cc (270mgI/L), 3 cc saline.
DLP: 13 mGy.cm

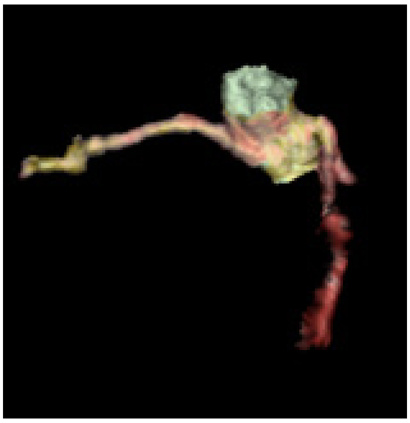


Curved and lumen reconstructions of right coronary artery.

Volume rendering reconstruction showing aortic coarctation.



Curved reconstructions of left anterior descending coronary artery.



Coronary volume rendered reconstruction.

Conclusion

The ease of use, speed and excellent spatial and temporal resolution has reduced the amount of general anesthesia needed to image paediatric patients and ensures that CT will have an increasing role in cardiac imaging, especially in patients with congenital cardiac disease. //

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University Hospital of Nantes, France

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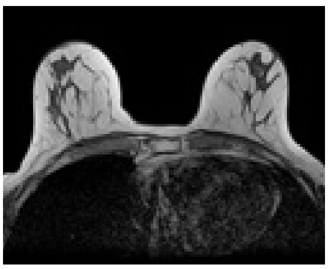
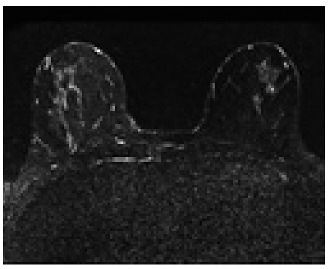
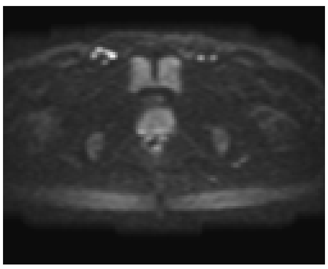
Vantage Elan has been chosen to receive the Gold Award at **"The Green Apple Awards for Environmental Best Practice 2016"**



Ax 3D T1



Ax T2 FS



Ax DWI B1000

Ax T2

The future of Breast Imaging

Aurélie Jalaguier-Coudray, MD
Chief of Women Imaging Unit in Institut Paoli-Calmettes, Marseille.

Could you please explain to our readers the role played by MRI in your daily breast cancer clinical practice, compared to echography and mammography?
Breast MRI is not systematically performed. In case of breast carcinoma, the indications of Breast MRI are detailed in France by the "Haute Autorité de Santé" and in Europe by the EUSOMA group.

In France, a breast MRI must be performed in patients with a histologically-proved breast carcinoma in the following cases:

- Age< 40 years.
- Eligible to a breast conservative surgery with oncoplasty surgery.
- Before a neo adjuvant therapy.
- When the clinical size is discordant with the size in mammography and ultrasounds.

Eusoma group recommends breast MRI in the same situations as above with the adjunction of two indications: first, in case of intraoperative radiotherapy and second, in case of lobular invasive carcinoma, which can be more frequently multifocal and multicentric than ductal carcinoma.

Moreover, breast MRI is a very helpful imaging technique for the radiologists in case of:

- Breast implants: to confirm the absence of intra or extra capsular rupture.
- Patients with high genetic risk: genetic mutations are identified for breast carcinoma. The two most known mutations are BRCA 1 and 2. Patients with this mutation are followed very early (30 y old) with annual breast MRI, mammography and ultrasound.

Among the diffusion imaging techniques, what is your opinion about IVIM to differentiate breast lesions?
Actually, diffusion-weighted imaging is not so used in clinical practice. Diffusion sequences often contain a lot of artifacts. There are some publications about IVIM and characterization of breast tumor but in clinical practice, IVIM is actually not used.

Dynamic contrast-enhanced acquisitions are predictive of malignancy depending on the type of kinetic curves. According to you, what are the future challenges to improve diagnosis with this method? Could a quantitative analysis provide additional information to the qualitative estimate?
Today, to characterize a breast lesion, the margins are the most important criteria to predict a suspicious lesion and perform a breast biopsy. The radiologist focuses more specially on the margins of the lesion, like in mammography and ultrasound.

The kinetic curves can be used but in current practice benign lesion such fibroadenoma could have a wash out (curve 3) like a breast carcinoma and, conversely, an invasive lobular carcinoma could have a progressive enhancement (curve 1) like a benign lesion. As opposed to cervical carcinoma, breast carcinoma has no typical enhancement curve and quantitative analysis.

The use of quantitative analysis in breast MRI has been previously reported to predict the response of neo adjuvant therapy, especially with a MRI after the first cycle of neoadjuvant treatment.

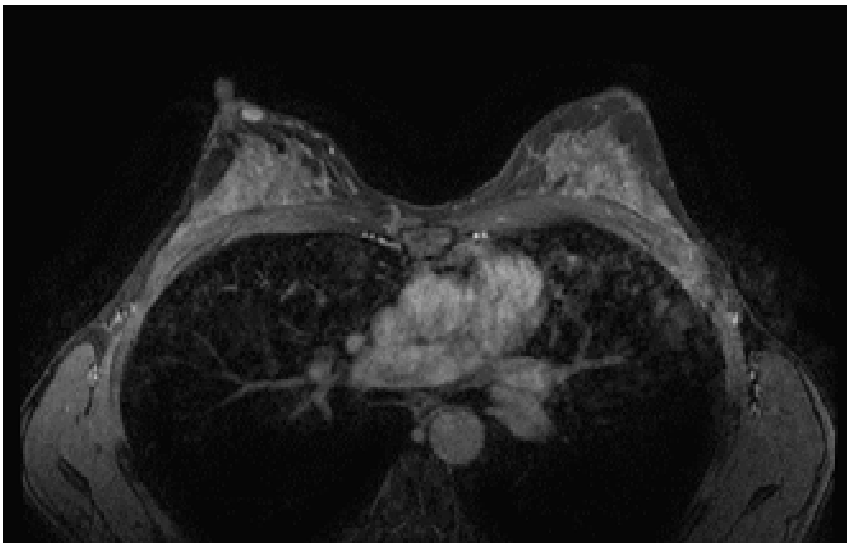


Figure 1: Axial T1 weighted T1 image with fat suppressed showing a retro areolar mass with circumscribed margins, corresponding to a fibroadenoma.

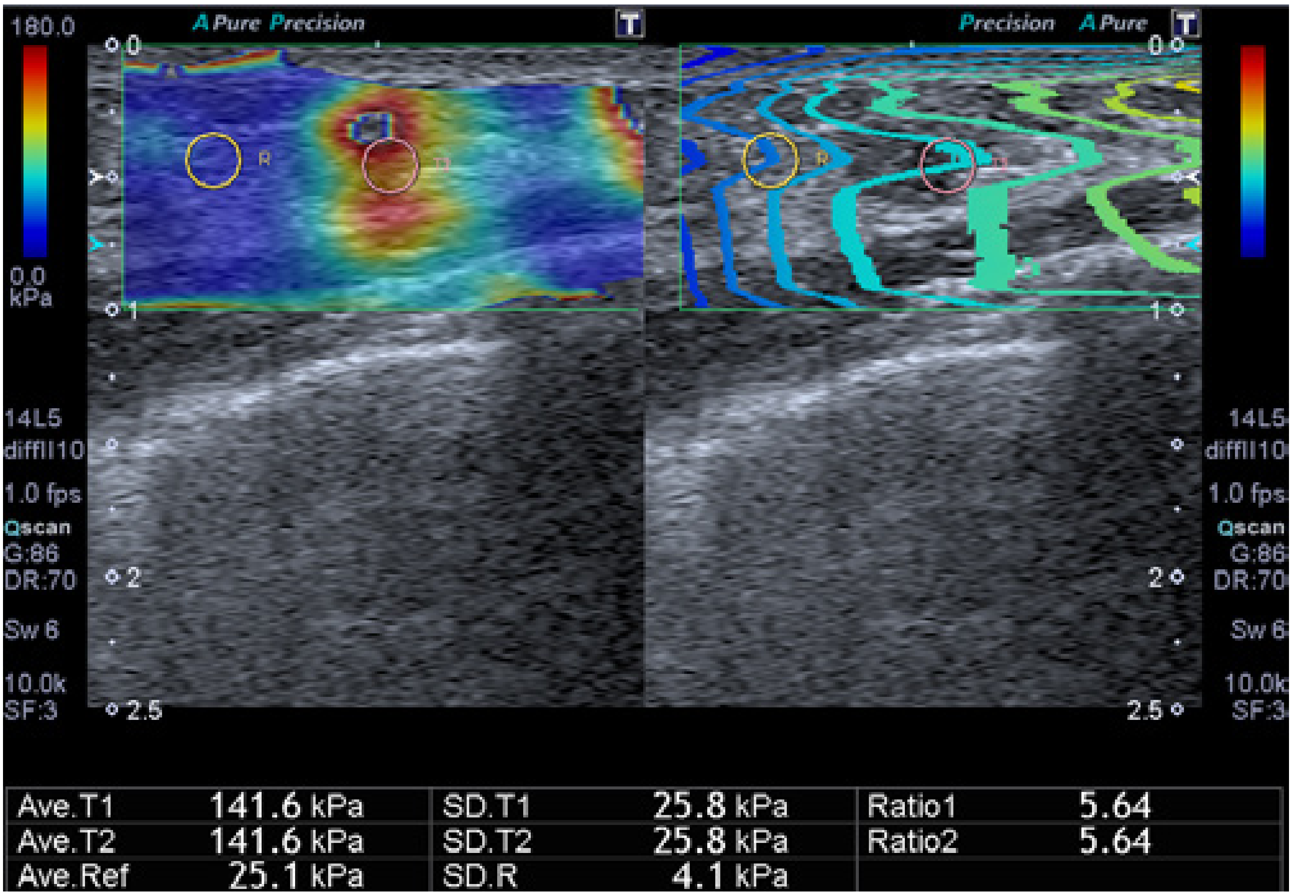


Figure 2: Elastography of a mass rated BIRADS 4.

"In the future, the number of unnecessary breast biopsies must decrease due to an increasing number of breast MRI."

Elastography is a promising technique in the characterization of malignant tumors. Do you believe that it could shortly substitute to biopsy? What would be the benefit for the patient?
No, the studies previously published have not demonstrated that elastography could substitute to breast biopsy. But there is a benefit in the use of elastography, especially in case of intermediary lesion: BIRADS 3 or BIRADS 4.

If a lesion is rated BIRADS 3 with morphological criteria, the use of elastography could upgrade to BIRADS 4 in case of high elasticity. Also, a lesion rated BIRADS 4 on the morphological criteria could be classified as BIRADS 3 with the adjunction of elastography (low elasticity).

Based on your experience, how could MR deliver new data in the near future? Which type of information would you expect?
Breast MRI has a very high sensibility with a low specificity leading to a high number of benign lesion to be detected and biopsied. It will be very helpful for the radiologists to increase the specificity of MRI.

What will MRI look like in the future?
Currently, the use of gadolinium chelate is under debate because of the presence of gadolinium deposits found in the brain. The French radiology society recommends limiting the number of injections in children, young patients. BRCA patients begin their breast MRI at 30 with at least 1 MRI per year. In such patients, a breast MRI without injection of gadolinium will be a real benefit. In the future, and I hope so, the number of unnecessary breast biopsies must decrease due to an increasing number of breast MRI. //

First publication in Olea Imagein, Issue Number 3, March 2017

Experience with a Real Time Patient Skin Dose Distribution Estimator for Interventional Radiology

Source: Poster: ECR 2017 / C-0774
E. Vano, R.M. Sanchez, J.M. Fernandez, J. Ignacio Ten, J.V. Mendez, J. Armijo, M. Leyva, C.J. Gonzalez

During Interventional Radiology practices, it might be necessary, in some cases, to deliver high radiation doses to the patient's skin[1,2]. When procedures are complex or when various procedures are necessary to treat patients, high Peak Skin Doses (PSD) may produce several degrees of skin lesions, from a transient erythema with low PSD (2-5 Gy), to the most severe moist desquamation and necrosis when PSD are greater than 15 Gy[3-5].

To avoid or minimize skin lesions in patients during procedures, interventionalists have limited information. In most interventional laboratories, only dose indicators like fluoroscopy time, dose area product (DAP) or air kerma at the patient entrance reference point (AK) are displayed on the interventional laboratories screens during the procedures. These indicators give specialists a general summary on patient dose, but they are not directly related to the patient skin dose maps[6]. Some authors have estimated the patient PSD by using photo-stimulated plates and slow and radiochromic films, a method that results both expensive and time consuming[7-9]. The DICOM radiation dose structured report (RDSR) is currently available on updated X-ray units. That report includes detailed information at radiation event level and can be used to estimate the patient skin dose distribution. Unfortunately, X-ray units deliver the RDSR at the end of the procedure, so that no actions can be taken to minimize the PSD during the procedure. What is more, in many cases, manufacturers do not include all the event parameters necessary to accurately calculate the patient PSD in the RDSR.

In this work, an evaluation of a skin dose distribution estimator in real time is presented and pros and cons are discussed. The PSD estimation is compared with a measurement performed using radiochromic films on an anthropomorphic phantom. The PSD delivered to patients over a period of 10 months is analysed.

Methods and materials

The system developed to estimate the patient skin dose distribution is commercially available under the name Dose Tracking System (Toshiba Medical)[10-11] and has been installed in a new Interventional Radiology laboratory at the Hospital Clínico San Carlos (Madrid, Spain).

The system captures, in real time and for every radiation pulse, the information relative to all physical parameters during patient irradiation, i.e. C-arm position and angulation, couch height and position, tube and generator settings as kV, mA, pulse time, filtration, beam collimation and compensator wedges. Finally, the system computes the skin dose using an anthropomorphic model and displays the

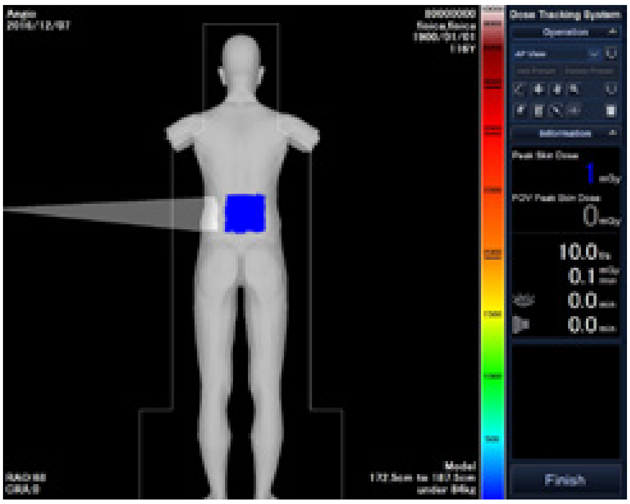


Figure 1: System display located in the angiography room. In blue the dose map (with a PSD of 1 mGy). The beam direction (light grey) is angulated to avoid the irradiated area. The parameter FOV Peak Skin Dose shows the skin dose in the area where the C-arm is pointing.

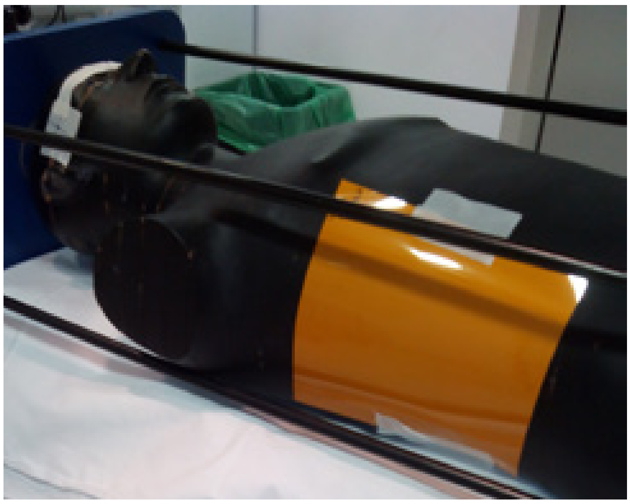


Figure 2: The anthropomorphic phantom over the examination couch with a radiochromic film to measure the skin dose distribution.

results on one of the screens inside the interventional laboratory. Along with the skin dose map, the system shows the patient region where the C-arm is pointing, the beam eye view and also the maximum skin dose in the beam area (figure 1). The user can select the anthropomorphic model to fit as close as possible to patient actual dimensions, including male and female models and also paediatric patients.

The system was tested using a Rando anthropomorphic phantom (Radiology Support Devices, USA). Several pieces of radiochromic films (GafchromichXR RV3 (ISP, USA)) were located at phantom surface covering the back and the right side (figure 2). The film was calibrated for the beam quality of the X-ray unit used with DSA (digital subtraction angiography) runs of 80 kV and 0.1 mm Cu of added filtration and using an ionization chamber Radcal 20x60 (Radcal Corp, USA). Films were digitized using the scanner Epson Expression 10000XL and the images were processed to transform digitized images into patient dose distributions, following manufacturer recommendations. The phantom with the films was positioned at the examination couch and irradiated like a patient. Two cases were created, a simple one with two projections using just the DSA beam quality and rotating the C-arm, and a second one for a more complex procedure using several beam qualities (DSA and fluoroscopy runs) and with many projections moving the couch and the C-arm.

Since the system was installed, skin dose distribution reports for every patient have been stored in html format in an independent server as the current version still does not integrate this information into the RDSR or into the folder study stored in the PACS. A summary of the results showing PSD values is presented. The correlation with the main dose indicators (PDA, AK) is analysed.

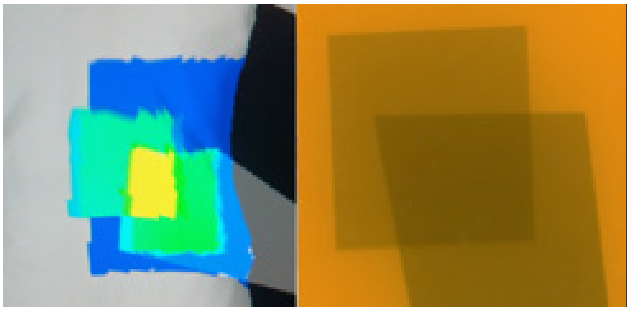


Figure 3: The dose map at system report (left) and at film measurement (right). Simple case with 2 DSA projections. The PSD at radiochromic film was 1593 mGy. The system reported 1514 mGy (-5%).

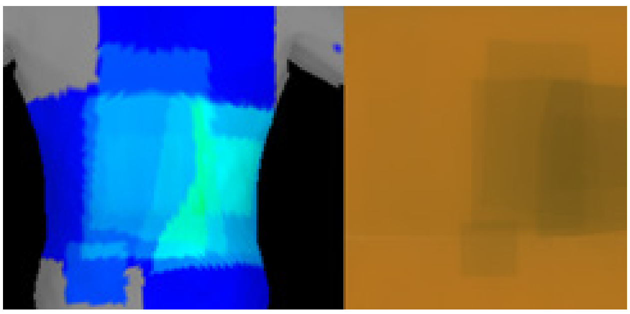


Figure 4: The dose map at system report (left) and at film measurement (right). Complex case with many projections (fluoroscopy and DSA) with different beam qualities and couch movement. The PSD at radiochromic film was 820 mGy. The system reported 743 mGy (-10%).

Results

Figures 3 and 4 show a comparison between the dose distribution measured with the film and the system estimation for the simple (figure 3) and the complex (figure 4) cases. In the simple case, the difference in peak skin dose between the estimator and the film was -5%. For the more complex procedure, the difference was -10%. Taking into account the uncertainty of radiochromic films[12-14], the differences found may be considered as not significant in comparison with other sources of inaccuracies deriving from coupling film-phantom surfaces or the different film response to different beam qualities.

Figures 6 and 7 presents, for the cases of high PSD (>1000 mGy) the correlation between the PSD and the DAP and AK, the two main dosimetric indicators given by the majority of modern interventional C-arms. Both indicators shows a bad correlation when analyzing the most interesting cases with high PSD.

After the system had been installed and over a period of 10 months, a sample of 410 skin dose maps were recorded. Table 1 summarizes the main results extracted from the sample. The average PSD was 151 mGy, with the majority of procedures (90%) with PSD under 315 mGy. Most of the low PSD values resulted from the low complexity procedures performed in this room. But a 2% of patients received PSDs greater than 2 Gy, the threshold dose that could produce skin lesions: the maximum value of PSD recorded was 3.9 Gy in an abdominal angiogram, followed by a complex upper mesenteric artery angioplasty (figure 5). The air kerma at the patient entrance reference point displayed by the angiography room was only 2.2 Gy, almost half of the peak skin dose, showing that this parameter is not always sufficient (or a good indicator in all the cases) to discriminate high PSD values. In this case, the PSD was almost double the cumulative AK, as in the lateral projection the skin was closer to the X-ray tube focus than to the reference point (15 cm from isocenter towards X-ray focus). Patient was proposed for ulterior angioplasty with stent to be performed two months later. Interventionalists needed to deliver 1.6 Gy of AK, but they took into account the skin dose information from the previous procedure to avoid the skin region previously irradiated and thank to this, the patient did not develop skin lesions during the clinical follow-up.

Conclusion

The system evaluated shows interventionalists real time PSD with enough accuracy (around 10%). The parameter air kerma at the patient entrance reference point can underestimate the skin doses when lateral projections happen to be predominant. The graphic

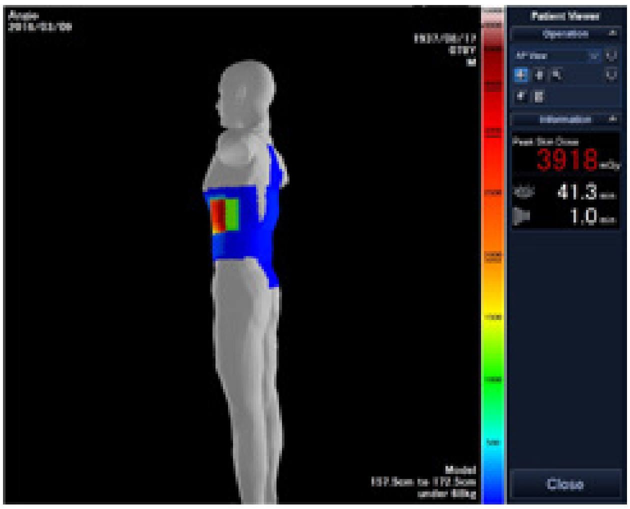


Figure 5: Case with the maximum peak skin dose.

interface allows specialists to change the beam orientation and optimize the dose distribution to reduce the peak skin dose if clinical conditions permit. Most of the procedures recorded were under 500 mGy of PSD, but a 2% of the sample in our survey resulted in PSD greater than 2 Gy. The system helps identify high dose procedures with better accuracy than would the analysis of the global DAP or AK and it also helps assess the appropriateness of a follow-up of possible skin injuries. The aspects to be improved in the future should be the integration of this information in the RDSR and the possibility to generate automatic alarms suggesting clinical follow-up at the end of the procedures.

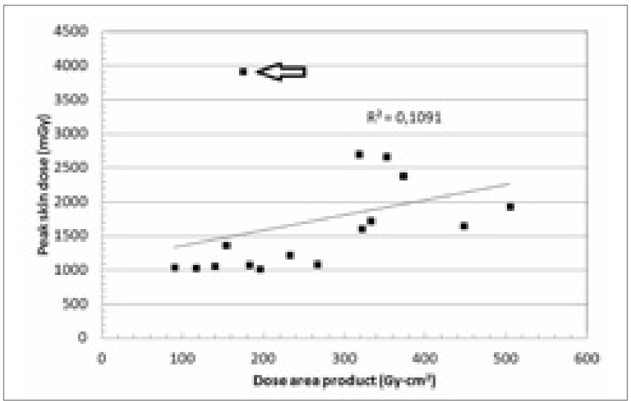


Figure 6: The peak skin dose versus the dose area product. The arrow points to the case shown in fig. 5.

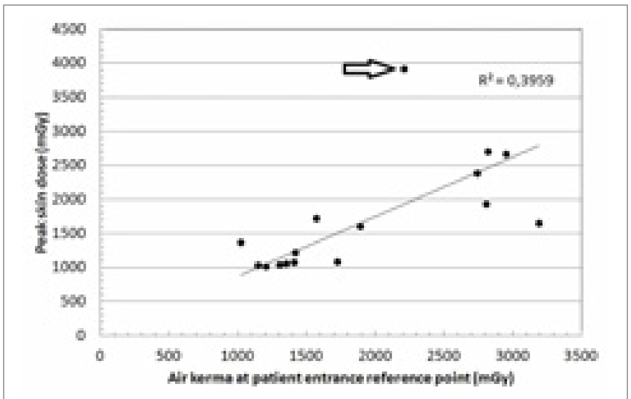


Figure 7: The peak skin dose versus de air kerma at patient entrance reference point. The arrow points to the case shown in fig. 5.

N=410	PSD (mGy)
Min	1
Max	3918
Average	151
Std Deviation	407
P25%	6
Median P50%	19
P75%	91
P90%	315

Table 1: Main statitistics from the PSD in the sample.

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Evolution of Diagnostic Ultrasound Systems – Current Achievements in Breast Ultrasound

Dr. Ayumi Izumori, M.D.

50 years of medical research, development, and manufacturing from Toshiba Medical ultrasound has culminated in the introduction of the Aplio™ i-series. The innovative, intelligent, and intuitive features of the system will be introduced hereafter.

Ergonomics

Aplio i-series has a high level of development focus on ergonomic features. The system is more compact and the system height range has been increased to provide an optimum working environment for all operators. Range of motion of the monitor and operating panel have also been expanded, improving ergonomics by increasing operator comfort when viewing the monitor or operating the control panel. Workflow has been enhanced as the control panel has been simplified with key multi-function buttons positioned around the trackball. The all new on-screen navigation on the monitor allows the operator to track and operate the trackball and associated function keys with their eyes remaining on the monitor, saving time and keeping the focus on the patient.

A second console is available through Wi-Fi connection with the main unit. This wireless tablet displays images from the Aplio i-series simultaneously and enables remote interactive operation between the tablet and the main unit.

Newly developed high frequency transducers

Two new high-frequency transducers were developed for Aplio i-series: the ultra-wideband high frequency linear transducer i18LX5 and the ultra-high frequency transducer i24LX8.

iBeam forming and Intelligent Dynamic Micro-Slice (iDMS) technology ensures the formation of sharp, uniform and thin slice beams in both lateral and lens directions delivering clinical images with higher resolution, more homogeneity, and enhanced penetration.

The ultra-wideband high frequency linear transducer i18LX5 covers the frequency range normally covered by two transducers, combining the advantages of optimum resolution and penetration in one transducer. Compared with conventional linear transducers, the 2-in-1 transducer can delineate the breast structure with high spatial resolution from Cooper's ligaments near the skin surface to the border of fascia and pectoralis major muscle in the deep region (Figure 1). The i24LX8 transducer is expected to be useful for visualizing clinical targets such as mucinous carcinomas located in deeper regions and where difficult to be distinguished from fatty tissue using a conventional transducer due to blurring.

The new i-series linear transducer i24LX8 offers an ultra-high frequency (UHF) up to 24MHz with outstanding spatial resolution while maintaining penetration as with conventional linear transducers. The elevated frequency range and unprecedented high resolution offer the capability to observe internal structure of a comedo-type ductal carcinoma in situ (DCIS) including the stroma structure, epithelial hyperplasia and echogenic foci (Fig. 2).

Doppler Imaging

The resolution and the sensitivity of color Doppler imaging have been further improved with the Aplio i-series. The enhanced image quality increases the detectability of minute vessels (Fig. 3).

The i-series' iBeam technology further increases the sensitivity of Superb Micro-vascular Imaging (SMI). This more advanced SMI provides clearer visualization of low-velocity flow in minute vessels

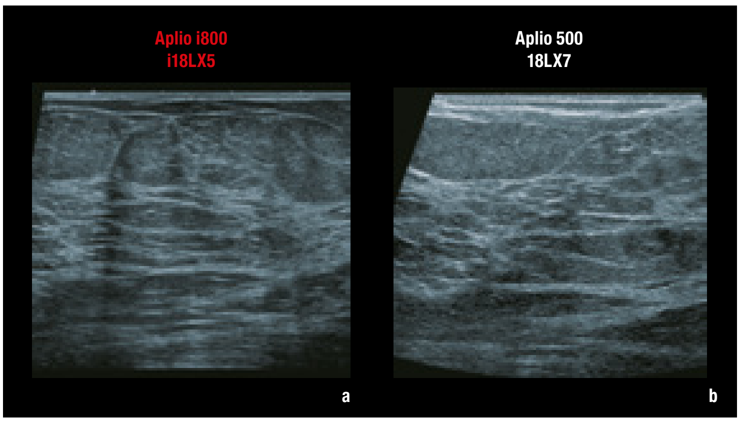

Figure 1: Comparison between ultra-wideband transducer i18LX5 in Aplio i-series (a) and conventional linear transducer 18LX7 (b).

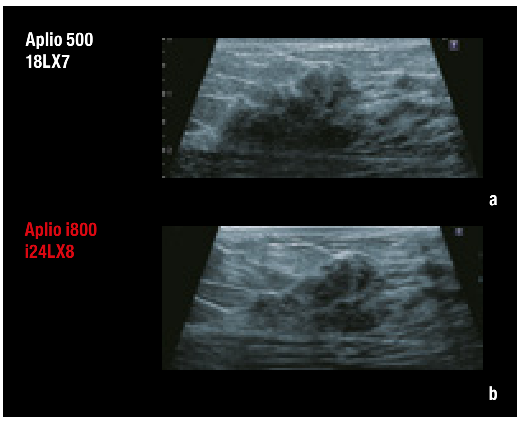

Figure 2: Comparison between 18LX7 (a) and ultra-high frequency transducer i24LX8 of Aplio i-series (b).

with more details. Applying the "hold" function allows accumulation of SMI images and provides depth perception for overview of the vasculature in 3D. SMI can be activated with one button and delivers detailed vasculature information without the use of contrast medium, enabling fast and precise diagnosis of vascular structures which is important for lesion differentiation and treatment evaluation.

Evolution of B-mode image quality

Interpretation of deviations from the normal structure using 3D breast ultrasound images is an innovative method for breast cancer evaluation. The evaluation of B-mode image quality provides ultrasound images with high resolution that encourages this new clinical approach. Image quality is the number one priority for breast ultrasound and it is essential to investigate the pattern of the internal structure to perform breast examination precisely. Although images with high contrast resolution are generally preferred for easy detection of breast lesions, hypoechoic areas in normal tissue might resemble malignant lesions which can lead to false-positive results. With the enhanced spatial resolution produced by the i-series transducers, normal breast tissue and pattern of the hypoechoic regions can be clearly depicted (Fig. 4).

In order to guarantee accurate diagnosis for differentiation of malignancy on normal breast tissue, high resolution ultrasound images are essential to observe its internal structure. However, some operators feel that ultrasound images with increased resolution are associated with a decrease in contrast, so they prefer images with high contrast for easy visualization. Nevertheless, when compared with histological findings, ultrasound images with higher resolution provide morphological information that is closer to the actual histology. As a result, high resolution ultrasound images are important for differentiating abnormalities in breast tissue.

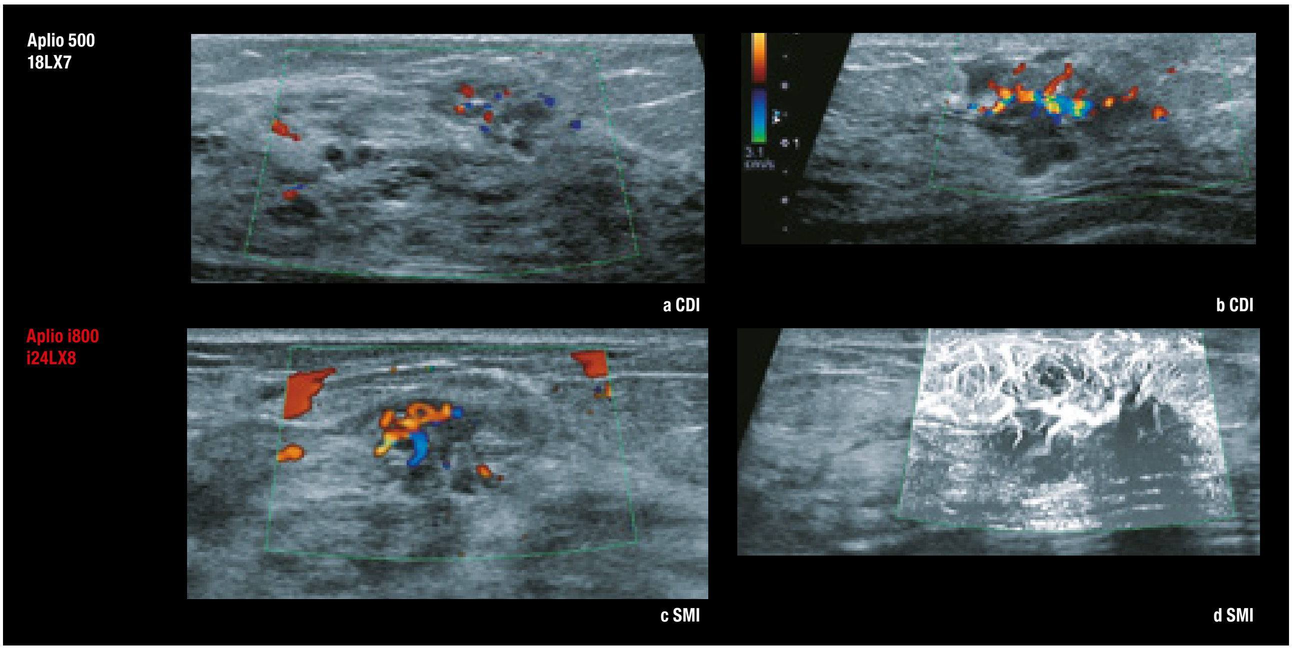

Figure 3: Comparison between 18LX7 (upper) and i24LX8 (lower) in color Doppler (a, b) and SMI mode (c, d).

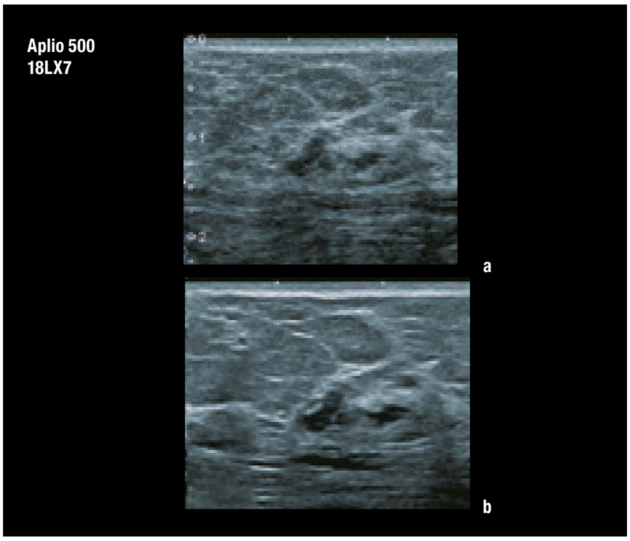

Figure 4: Comparison of image quality on breast ultrasound between 18LX7 (a) and i24LX8 (b). Using the ultra-high frequency transducer, the internal structure of the hypoechoic region can be visualized clearly (b).

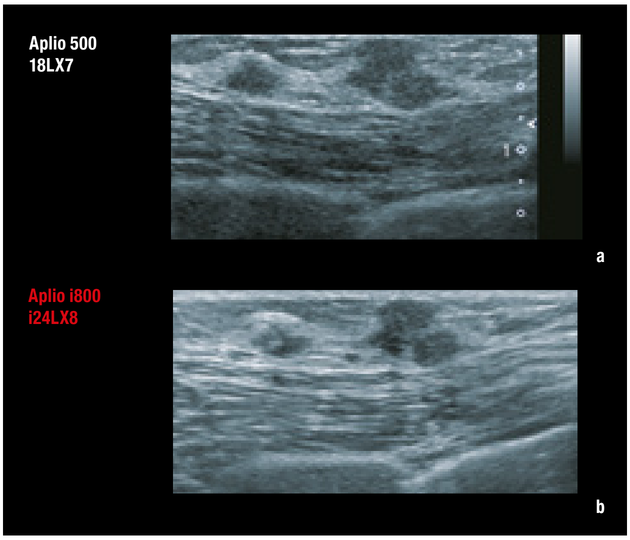

Figure 5: Comparison of invasive cancer between 18LX7 (a) and i24LX8 (b). Aplio i-series has high contrast resolution that can clearly detect the lesion and its halo sign.

Traditionally, it is necessary for the operator to decide image quality based on the trade-off between visibility and resolution. But with Aplio i-series and its newly developed transducers, internal structure of breast lesions is seen with high contrast resolution and spatial resolution. In the previous version of BI-RADS, the feature of halo sign is an indication for invasive cancer. In Fig. 5, a halo sign is clearly delineated by using the ultra-high frequency transducer, thus invasive cancer such as scirrhous carcinoma can be detected easily. In addition, the visibility of minute lesions and calcification have been improved. Detailed examination on echogenity and evaluation of extent of infiltration can be performed more easily.

Because of the excellent spatial resolution of the new ultra-high frequency transducer, both the area under the skin surface and structure of the nipple can be observed. This provides clinical value for evaluating extent of infiltration towards the nipple direction from invasive tumors.

Aplio i-series has impressive spatial and contrast resolution for detecting deviations from the normal structure (Fig. 6).

When investigating the isoechoic normal breast tissue with mottled pattern, the internal structure of slight hypoechoic stroma surrounding lobules can be depicted clearly. Compared to conventional transducers, isoechoic structures can be detected more easily, allowing fast detection of deviation from normal breast tissue. As discussed above, the new ultra-high frequency linear transducer is a unique transducer that ensures both excellent visualization.

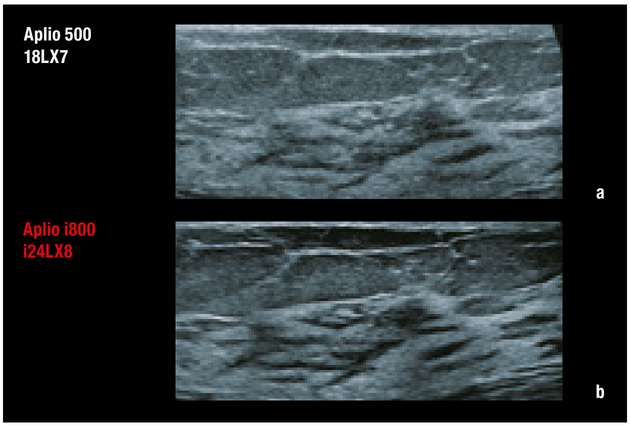

Figure 6: Comparison of normal breast tissue between 18LX7 (a) and i24LX8 (b). Aplio i-series has impressive spatial and contrast resolution in normal tissue (b). The approach of "deviations from the normal structure" can be performed easily.

Importance of high resolution imaging in routine breast ultrasound

Normal breast tissue is heterogeneous and the internal structure of breast lesion can be highly variable. The author proposes a method to determine whether a lesion requires detailed examination or follow-up by interpreting the internal structures of the lesions. With the high resolution delivered by Aplio i-series, accurate diagnosis can be performed easily and the following approach can be incorporated into routine breast ultrasound.

For lesions where deviations from normal structure are found, if the deviations have a regular pattern, follow-up examination is suggested. In contrast, if the deviation pattern is irregular and there is disorderly proliferation, the lesion is suspicious for malignancy and detailed examination will be required.

Operators in our institute conduct ultrasound examinations based on the approach described above. In the prospective study of this approach, almost all clinical cases that are diagnosed based on collegial discussions to require follow-up examination are confirmed to be benign. Although a few patients with benign proliferative breast lesion were diagnosed to require detailed examination, no patients with malignant lesions were misdiagnosed as having benign lesions.

Neoplasms

Fig. 8 shows an example of a papillotubular carcinoma. Because of the expanded frequency range from the ultra-high frequency transducer, more detailed information of the internal structure can be obtained compared to conventional linear transducer, promising accurate diagnosis. Echogenicity and irregularity inside the lesion can be clearly depicted. In addition, microlobulated margin can be distinguished easily.

A benign fibroadenoma was also found. With Aplio i-series, a homogenous, hypoechoic, and well-encapsulated lesion was visualized, indicating that it was a cystic lesion. The lesion can be confirmed as fibroadenoma and only follow-up is required (Fig.9).

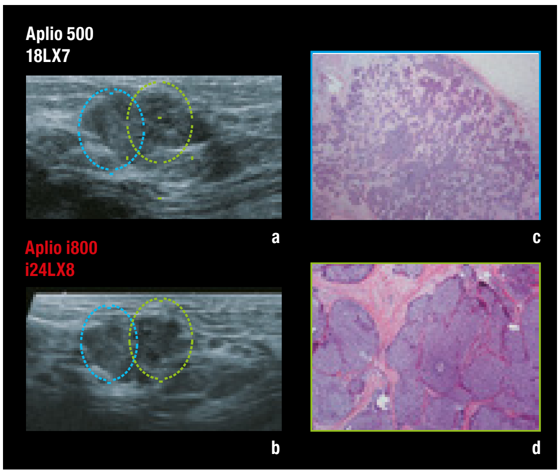

Figure 7: Papillotubular carcinoma (detailed examination). (a) 18LX7, (b) i24LX8 and (c,d) HE-stained specimens.

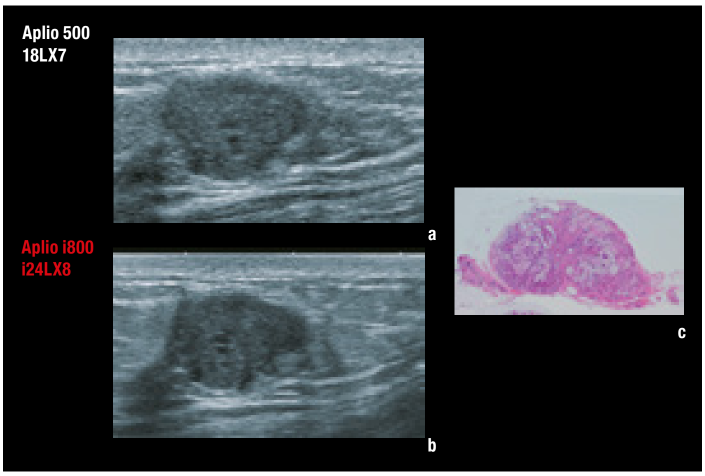

Figure 8: Fibroadenoma (Follow-up). (a) 18LX7, (b) i24LX8 and (c) HE-stained specimens.

With improvement in grayscale image quality, diagnosis can be performed with more ease and accuracy.

Diffuse breast pathology

Fig. 9 shows a case of diffuse cystic mastopathy. In the fibrocystic region, a large amount of hypoechoic stroma and multiple cysts can be observed. Benignancy can be confirmed as hyperechoic stroma with regular pattern pass through the lesion. Internal structure might be difficult to interpret with conventional transducers. However, with Aplio i-series, homogeneous echogenicity in the stroma can be observed and the hypoechoic area can be confirmed to be homogenous. The lesion can be easily evaluated as cystic.

Fig. 10 shows an example of a comedo-type DCIS. Without the ultra-high frequency transducer, region of adhesion might be difficult to be distinguished in the internal structure. Aplio i-series can detect the distorted isoechoic pattern of the partially hyperplastic mammary ducts. The lesion is diagnosed as malignant and detailed examination is required. The internal structure can be observed in detail based on the extraordinary image quality, offering fast and accurate diagnosis, and facilities target to be identified easily during breast biopsy.

Infiltrating tumors such as scirrhous carcinoma, invasive lobular carcinoma and papillotubular carcinoma are difficult to be detect by mammography due to their diffuse growth pattern. In contrast, because of its high spatial resolution, ultrasound imaging is one of the state-of-art methods for detecting these infiltrating tumors.

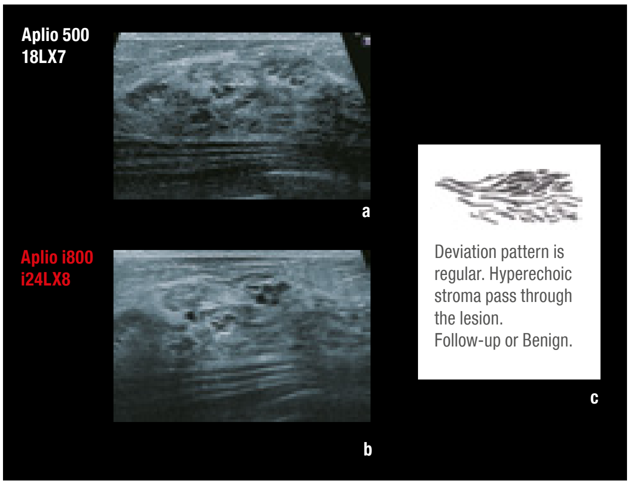

Figure9: Diffuse cystic mastopathy with (a) 18LX7 and (b) i24LX8. (Follow-up). Thickened, hyperechoic stroma demonstrating benignancy (c).

The new ultra-high frequency transducer has excellent contrast and spatial resolution for the evaluation of internal structures of breast lesions. It provide significant clinical benefit as malignant lesions that require detailed examination can be identified earlier and extent of tumor infiltration can be diagnosed accurately. In addition, ultrasound-guided biopsy can be performed precisely with the help of ultrasound images with clear border and internal structure of the lesion. Increase of positive predictive value and further development of ultrasound examination can be strongly expected.

New features in volume imaging

One of the new features of Aplio i-series is Smart Sensor 3D. Smart Sensor 3D technology creates reconstructed images from free-hand 2D acquisitions. Volume transducers can reconstruct 3D breast images, however, there can be limitations due to volume size. Using ultra-high frequency transducers with Smart Sensor 3D, breast images with extraordinary resolution can be obtained at arbitrary directions.

Shadow Glass is an advanced 3D rendering software that utilizes the voxel data obtained by Smart Sensor 3D to create semi-transparent glass rendering effect on breast tissue. By controlling the transparency of the skin and breast tissue, regions with high contrast and heterogeneity can be investigated. The ability to analyze the internal structures of breast lesions adds more clinical value to volume imaging (Fig. 11).

The reconstructed images can be observed in different angles by either rotating the rendered image or adjusting position of the ambient light source. 3D overviews of internal structure and vasculature of tumors can facilities the surgical planning and evaluation of treatment.

As voxel data can be acquired easily, automatic measurement of tumor volumes for evaluation of chemotherapy might be possible in the near future.

Furthermore, side-by-side display of a previously acquired image and real-time ultrasound might be useful for comparative imaging study as well as for the evaluation of chemotherapy.

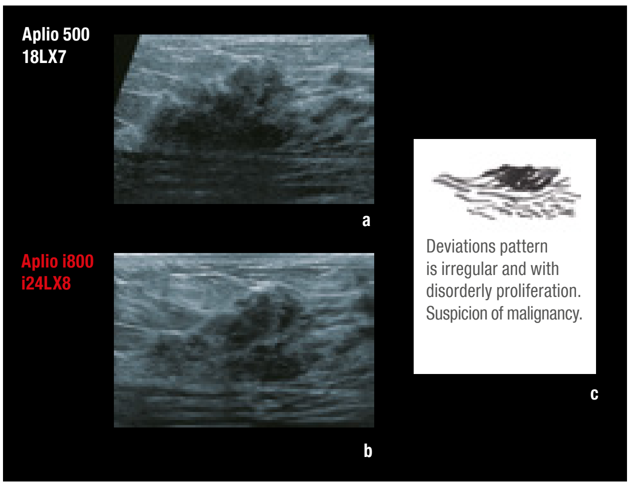

Figure 10: Comedo-type DCIS with (a) 18LX7 and (b) i24LX8. (Detail examination). Dense, hypoechoic structure demonstrating malignancy (c).

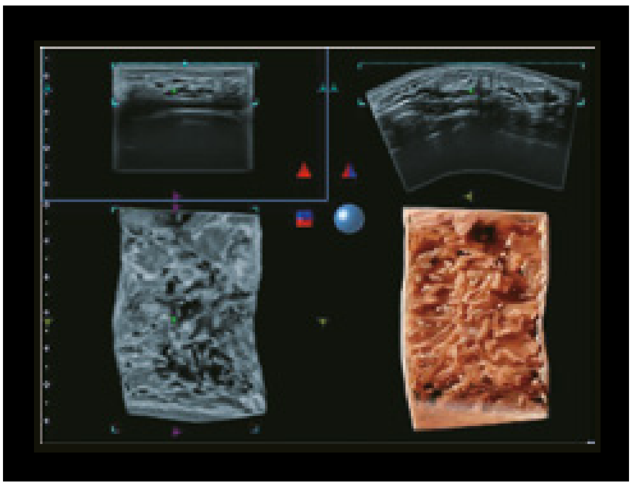

Figure 11: Shadow Glass. On the lower-right corner, internal structure of the lesion is visualized in 3D.

Conclusion

The newly developed high frequency transducers for Aplio i-series deliver unprecedented spatial and contrast resolution for obtaining crystal-clear clinical images. With the enhanced image quality, detection of deviations from the normal structure can be performed easily. Moreover, detailed examination can be done with high accuracy, even by less-experienced operators. The internal structure of the breast can be observed on detailed 3D images acquired by using the 2D ultra-high frequency transducer combined with Smart Sensor 3D. This may lead to increased positive predictive values in breast examinations. Evaluation of treatment effect and inspection of breast lesions using grayscale imaging can be performed with high accuracy. The Aplio i-series is expected to take breast ultrasound to the next level. //

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[1] Izumori A, Horii R, Akiyama F, Iwase T. Proposal of a novel method for observing the breast by high-resolution ultrasound imaging: understanding the normal breast structure and its application in an observational method for detecting deviations. Breast Cancer. 2013 Jan;20(1):83-91.

DWI of the Prostate

François Cornud, MD / Thibaut Pierre / Paul Legmann, MD

Should we use quantitative metrics to better characterize focal lesions originating in the peripheral zone?

DW-MRI of the prostate plays a central role in prostate MRI. It is considered as the dominant sequence in the peripheral zone (PZ)[1]. If combined with T2W images, it also improves the accuracy of MRI for the detection of transitional zone cancer (TZ Ca)[2,3].

To characterize a focal lesion visible on MRI, a 1 to 5 scale is used. A score of 4 or 5 results in a cancer detection rate of 70-100%[4], whereas a score of 1 or 2 has been found to generally represent benign tissue[4]. As a result, it is now recommended to routinely perform MR-targeted biopsy of score 4 or 5 lesions, while considering deferment of biopsy for low-probability lesions.

However, management of score 3 lesions remains unclear, because the visual assessment of the combination of the Signal Intensity (SI) on the apparent diffusion coefficient (ADC) map and source DW images (dark on the ADC map and bright on source DW images), which characterizes score 4 and 5 lesions, is not straightforward in score 3 lesions. Visual assessment of these lesions is labelled "mildly hypointense" on the ADC map and "iso or mildly hyperintense" on the DW source images at a b-value >1000 s/mm² (i.e 1500 or 2000 in most studies), which entails a part of subjectivity.

Currently, targeted biopsies of score 3 lesions are recommended, but the cancer detection rate is low, approximately 20%[4], which contributes largely to the low specificity of the Likert or PIRADS scoring systems, lower than 50%[5]. The value of DW-MRI metrics deserved thus to be explored to improve the specificity of DW-MRI to characterize focal prostatic lesions, especially score 3 lesions. The most often used parameter has been the absolute value of the ADC, but several studies have proposed other parameters derived from the ADC map to improve the diagnostic and prognostic values of ADC metrics.

This review aims to show the different quantitative parameters available to evaluate the performance of quantitative MRI with a special focus on score 3 lesions.

Quantitative DWI and detection of PZ PCA

The ADC map

Numerous publications have established that the mean ADC value was significantly lower in prostate cancer (PCa) than in benign tissue[6]. However, the reported values of ADC in PCa showed great variations, ranging from 0.98 ± 0.22 $\times 10^{-3}$ mm²/s to 1.39 ± 0.23 $\times 10^{-3}$ mm²/s. One factor contributing to these variations is the selection of the maximal b-value among the studies. The higher the b-value, the lower the ADC value[7,8]. Also, the ADC value varies with the number of intermediate b-values[9] between 0 and 1000 s/mm² and with the inclusion of the b0 value, often discarded to avoid the perfusion effect (pseudo-diffusion).

Another finding shared by all studies is that, despite the significant difference of ADC values between cancer and benign tissue, an overlap could be noted between benign and malignant focal lesions[10]. Lastly, the two parameters used to measure the ADC value, diffusion time (Figure 1) and duration of application of the gradients[11] should theoretically be the same to compare ADC values across patients, but they are currently integrated together into one b-value. As a result, quantitative ADC metrics should be used with caution to better characterize focal prostatic abnormalities. To circumvent this limitation, the only reliable alternative would be for each center to define its own cut-off ADC value to differentiate PCa from benign tissue, according to the local DW protocol and MR platform used.

For example, in our routine practice, the mean ADC value is measured at the upper, mid and lower part of the lesion and the lowest value is the reference value. With regards to score 3 lesions (Table 1), we confirmed that cancer lesions had a lower mean ADC value than benign lesions (0.978 ± 0.146 vs 1.120 ± 0.115 $\times 10^{-3}$ mm²/s, p=0.02). The value of the area under the curve (Az) of the ADC value to differentiate PCa from benign tissue was 0.795. A sensitivity (Se) of 89% could be obtained at a cut-off value of 1.080$\times 10^{-3}$ mm²/s achieving a specificity (Sp) of 50%. This finding may help for the biopsy decision making in score 3 lesions, allowing for the deferral of 25% of immediate biopsies.

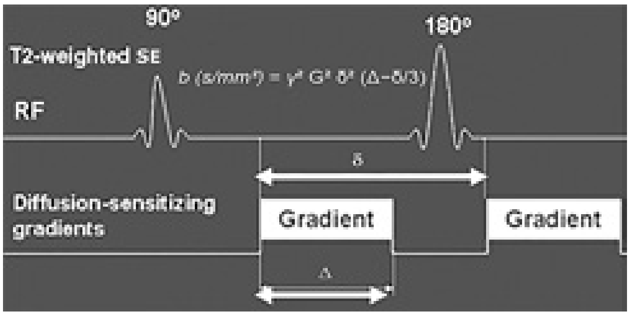

Figure 1: Water Diffusion Metrics (modified from[64]). Two rectangular gradient pulses of equal strength are applied before and after the 180-refocusing pulse of the turbo fast spin echo sequence. δ (diffusion time) is the time interval between the two gradient lobes, and Δ is the overall time interval during which the gradients are applied (gradient duration). The b-value (formula in brackets) is linearly related to Δ, but also to the square of δ. The values should thus be the same in every patient to have a valid comparison of ADC values across patients.

The ADC ratio

The ADC ratio consists of calculating the ratio of the mean tumor ADC value to that of a surrounding reference tissue. This intra-patient normalized ADC may compensate for equipment-related variations and improve the discrepant performance of absolute ADC values. To measure the ADC ratio, a region of interest (ROI) is placed in the contralateral benign PZ, in mirror position to the tumor.

A mean ADC ratio value of around 0.60-0.65 is the most often reported cut-off to differentiate PCa from benign tissue[12]. However, as for ADC metrics, the discriminant value of the ADC ratio showed conflicting results. Some studies[13] reported that the correlation coefficient with the presence of tumor was higher (0.883) for the ADC ratio compared with that obtained when the absolute ADC values were used alone (0.873). Other studies showed the opposite[12] by reporting that for PZ tumor detection the ADC value achieved a significantly higher Az value and specificity than the ADC ratio. With regard to score 3 lesions, our experience (Table 1) showed that the mean value of ADC ratio of tumors was not significantly different from that of benign lesions (0.57 ± 0.07 vs 0.61 ± 0.1). These discrepancies may be due to the fact that the benign PZ

Table 1: ADC metrics and derivates in 41 score 3 lesions (Cornud et al., unpublished data).

	Benign (32)	any Ca (9)	GS 3+3 (4)	GS 3+4 (5)
ADC (x10⁻³ mm²/s)	1.12 ± 115	0.9 ± 0.136 (p=0.003)	0.937 ± 0.15	1.01 ± 0.013 (p=0.45)
ADC ratio Mirror Whole Prostate	 0.61 ± 0.1 0.72 ± 0.09	 0.57 ± 0.07 (p=0.26) 0.6 ± 0.06 (p=0.0002)	 0 59 ± 0.06 0.53 ± 0.08	 0.56 ± 0.08 (p=0.14) 0.63 ± 0.03 (p=0.03)
WL ADC (x10⁻³ mm²/s) Mean 10% 25% 50%	 1.2 ± 0.0.155 1.08 ± 0.143 1.17 ± 0.142 1.17 ± 0.14	 1.06 ± 0.93 (p=0.02) 0.95 ± 0.15 (p=0.37) 0.99 ± 0.11 (p=0.10) 1.07 ± 0.106 (p=0.055)	 1.04 ± 0.59 0.93 ± 0.75 0.97 ± 0.74 1.04 ± 0.62	 1.08 ± 117 (p=0.5) 0.97 ± 0.19 (p>0.07) 1.01 ± 0.15 (p>0.05) 1.10 ± 0.13 (p>0.05)
SI ratio 1500 3000 6000	 1.7 ± 0.33 2.84 ± 0.95 6.49 ± 4.5	 1.8 ± 0.39 (p=0.13) 4 ± 1.26 (p=0.005 15.7 ± 12.7 (p=0.001	 1.8 ± 0.3 4.1 ± 1.4 18 ± 19	 1.9 ± 0.5 (p>0.05) 4 ±1.3 (p>0.05 13 ± 6 (p>0.05)

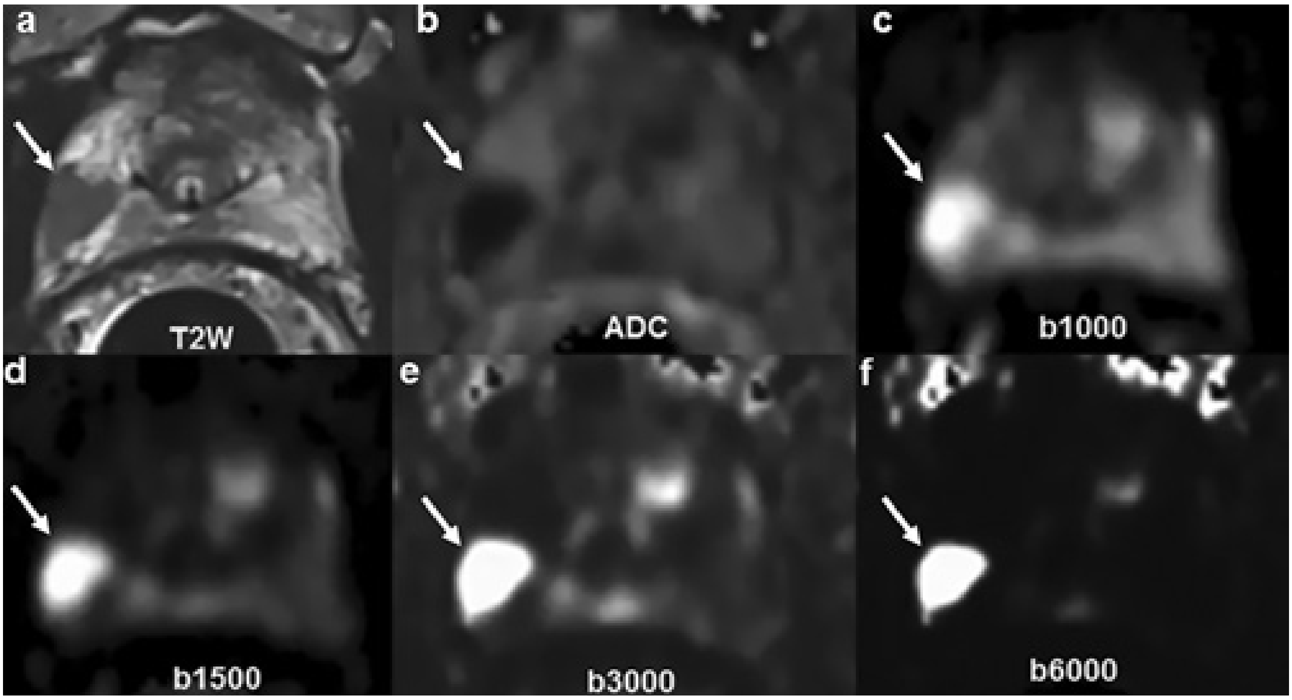

Figure 2: Very high computed b-values in a score 4 lesion. Right focal hypointensity on T2W (arrow, a) in the right lobe, dark on the ADC map (b), extracted from a b-50-500-1000 DW acquisition, and bright on the acquired b1000 images (c). As the computed b-value increases (d,e,f), the benign prostate is more and more suppressed, while the tumor remains bright.patient to have a valid comparison of ADC values across patients.

commonly shows variations of signal intensity related to the frequency of PZ benign changes such as prostatitis, fibrosis or atrophy[12]. As a result, we thought it could be more appropriate to define a more reproducible ROI to average the heterogeneity of the benign prostate (Figures 2 and 3). We thus calculated the Az of the ADC ratio by choosing the rest of the entire surface of the benign prostate, including the PZ and the TZ as the ROI of reference. In score 3 lesions (Table 1), the ADC ratio with this metric was significantly lower in Ca (0.6 ± 0.06) than in benign focal lesions (0.73 ± 0.09) ($p<0.0002$). The Az value was 0.89 and a cut-off value of 0.66 could detect any prostate cancer with a sensitivity of 90% and a specificity of 75% (Table 1).

Whole lesion ADC with values of the 10th, 25th, and 50th percentiles

Recent studies have shown that the prognostic value of more sophisticated ADC metrics derived from whole-lesion histogram assessment[14-17].

Such metrics may also represent an aid for the management decisions in score 3 lesions. A software is required for the segmentation of the lesion by placing a 3D volume of interest involving all slices showing the lesion. Whole-lesion ADC metrics (mean value and mean values determined by the 10th, 25th, and 50th percentiles) are then computed.

These metrics are supposed to provide a more robust assessment of the presence of low ADC values within the lesion than does the absolute minimum ADC value within any single voxel. In score 3 lesions, a study[18] showed that, in naïve biopsy patients, a whole lesion ADC value at the 25th percentile $\leq 1.04 \times 10^{-3}$ mm²/s achieved a 90% sensitivity and 50% specificity to suspect the presence of a Gleason score (GS) >6 tumor.

Comparison with the accuracy of the mean non-whole lesion ADC value was not available in the article.

In our practice (Table 1), we found that the mean whole-lesion ADC value of score 3 cancer lesions was significantly lower than that of benign lesions. The Az value was 0.76 and a cut-off value of 1.18×10^{-3} mm²/s could detect any tumor with a sensitivity of 89% and a specificity of 47%. However, the 10th and 25th percentiles were not significantly different between both groups.

Very high b-values images

To increase the conspicuity of tumor foci, the use of computed b-values of 1500 or 2000 s/mm² is recommended[19-23]. Computed high b-values images increase diffusion-weighting, allowing for a greater suppression of benign prostate, and thus improve the sensitivity of source DW-MR images for the detection of PCa (Figures 2 and 3).

More recently, several studies have reported a greater contrast between tumor and benign tissue at still higher computed b-values of 2500 to 4000 s/mm² [19,24-27], considering that b-values >2000 s/mm² can show a continual greater degree of benign tissue suppression. All these studies have evaluated the increase of the tumor conspicuity visually, so that no quantitation has been evaluated to define a cut-off value to differentiate PCa from benign tissue. However, in one of these studies[26], the ratio between the signal intensity of the PZ tumor and the rest of the PZ has been shown to steadily increase as the b-value was increasing, thus potentially defining a quantitative parameter to differentiate PCa from benign lesions. The rationale for such an approach is that computed DWI at very high b-values, up to 6000 s/mm², synthetized from measured images with b-values between 0 and 800 s/mm², yield a high contrast to noise ratio, because computed values are theoretically noise-free, hence not affected by the noise floor effect due to the non-normal Rician distribution of the noise[28].

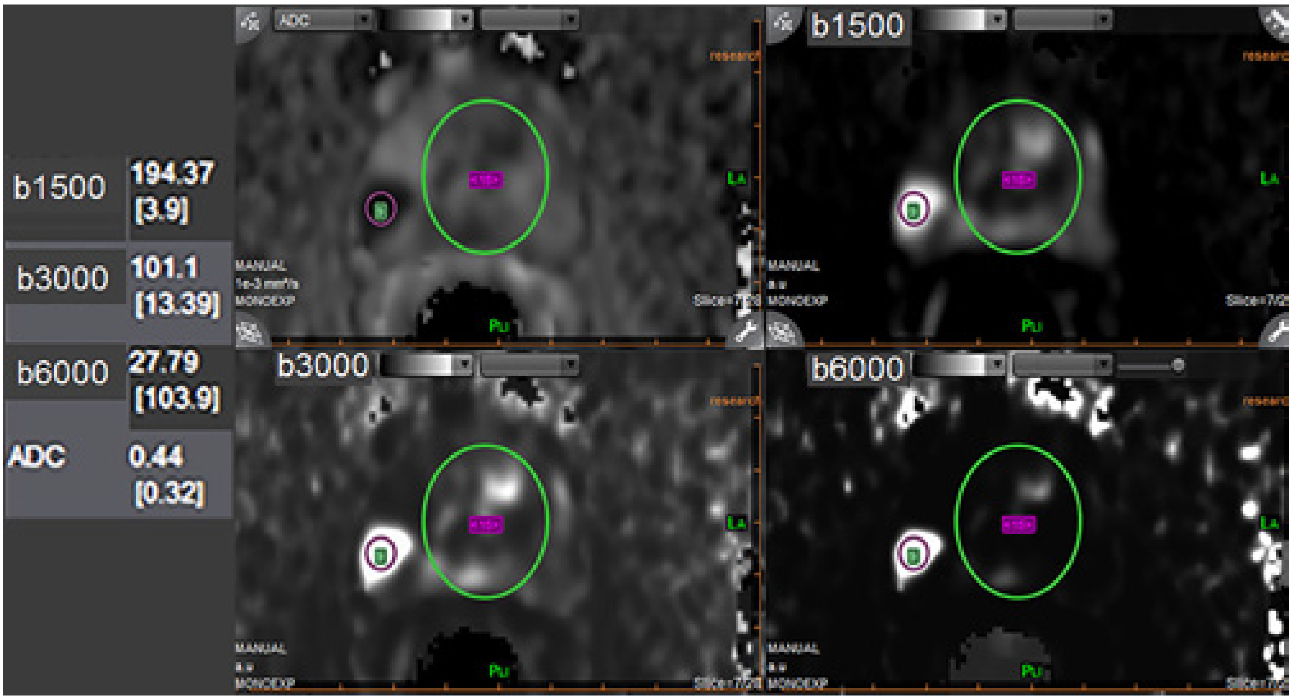

Figure 3: Signal Intensity Ratio metrics (same patient as in Figure 2). A reference ROI is placed on the tumor and a second one on the rest of the benign prostate. The ROIs are automatically propagated to all b-values and to the ADC map. The SI ratios are automatically calculated by the software. The value steadily increases from 4 to 104, as the b-values increase from 1500 to 6000 s/mm². Of note the low value of the ADC (0.44 x10^{-3} mm²/s) and of the ADC ratio (0.32) measured with the rest of the prostate as the reference ROI. Targeted biopsies showed a Gleason score 4+3 tumor with 70% G4.

These metrics can be evaluated using the Bayesian theory which has been successfully applied to improve the performance of ADC metrics[29,30]. This probabilistic approach is used in Olea Sphere® software to calculate more robustly, with regards to the noise level, the ADC value and to synthetize very high b-values.

Quantitative very high b-value DWI may thus represent an adjunct to the ADC map, especially in score 3 lesions, to differentiate PCa from benign tissue, at least in the PZ.

In our practice (Table 1), we studied the Signal Intensity Ratio (SIR) between the lesion and the rest of benign prostate on the same MRI slice including, as for the ADC ratio, the TZ and the PZ. Olea Sphere® software allows for a computation of an array of very high b-values. As shown in Figure 2, the benign prostate is more and more suppressed as the b-value increases and results in an increase of the SIR. With regard to score 3 lesions (Figure 3), we found that the SIR was significantly greater in cancer than in benign lesions at b-3000 (4 ± 1.26 vs 2.84 ± 0.95, p=0,005) and still significantly greater at b-6000 (15.7 ± 12.7 vs 6.49 ± 4.5, p=0,0012), but not at b-1500 s/mm². At b-3000, the value of the Az was 0.78 and a cut-off of 2.7 achieved a sensitivity of 100% and a specificity of 53% for the detection of any cancer. At a b-value of 6000 s/mm², the Az was 0.82 and a cut-off value of 7.6 achieving a sensitivity of 100% and a specificity of 66%, although the difference was not significant with results at a b-value of 3000 s/mm².

Quantitative DWI and assessment of gleason score of PZ cancer

Numerous studies have shown an inverse relationship between the ADC value and the surgical Gleason score of PCa with an overall correlation coefficient which varies from 0.32 (weak correlation) to 0.50 (fair correlation). The ADC value of Gleason 6 tumors is above 1 x10^{-3} mm²/s in all studies[7,17,31-43] but one[44] (range: 1.04-1.3), and is higher than that of Gleason score >7 tumors (range: 0.69-0.88 x10^{-3} mm²/s). All studies share showed a substantial overlap between the different subclasses, as indicated by the high values of reported standard deviations. Similarly, whole-tumor ADC metrics[14,45] showed that the mean and/or the mean 10th percentile ADC values were lower in Gleason 6 vs >6 tumors.

Results of ADC ratio metrics were discrepant, probably for the same reasons as for the diagnostic value of the ADC ratio (see above). Some authors[41,46] found a mean ADC ratio <0.50 in GS>6 tumors vs >0.50 in GS=6 tumors. In another study[47], using an unusual set of acquired b-values (0-800-1600), the Az value was 0.92 (p=0.12) for the ADC value and 0.86 for the ADC ratio (p=0.42), indicating no incremental value of the ADC ratio compared to that of the ADC value.

Several studies aimed to be more accurate and addressed the more specific challenge of intermediate grade tumors (Gleason score 7) which probably represents the true challenge of DW-MRI. Tumor aggressiveness is strongly related to the percent of Gleason grade 4 (%G4) components present within the tumor[48]. Stamey et al[49] demonstrated that biological progression after radical prostatectomy increased for each 10% increment of %G4 and the poorer prognosis of Gleason score 4+3 vs 3+4[50] has been well-established[51].

The accuracy for the detection of the %G4 has been significantly increased these past years thanks to MR-targeted biopsies, but some limitations, namely the detection of small amounts of Gleason grade 4 and the determination of the primary grade of Gleason 7 tumors can still be noted[52] (Table 2). Several studies[7,17,33,35,38,42] compared ADC values of Gleason score 74+3 vs 73+4 and discrepancies could

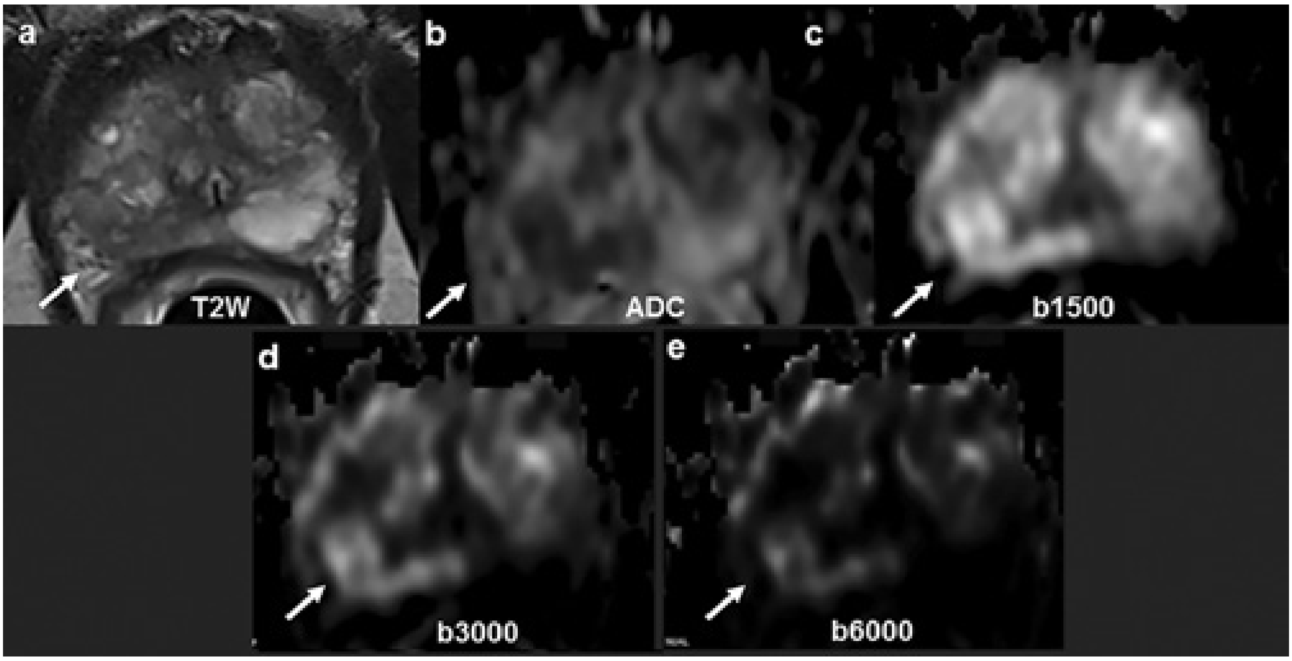

Figure 4: Very high computed b-values in a score 3 lesion. 67 y/o man. PSA: 18 ng/ml. Two series of systematic negative biopsies. Right focal hypointensity on T2W images (arrow, a) in the right lobe, dark on the ADC map (b) and isointense on the acquired b-value of 1500 s/mm2 (c). As the computed b-value increases (d,e), both the benign prostate and the lesion are increasingly suppressed.

be noted. Some authors[17,42] failed to show a significant difference between both groups, while four studies[7,33,35,38] found the difference to be significant. Whole-lesion ADC metrics similarly failed to find a significant difference between the two categories of Gleason Score[17,53].

These discrepancies may be due to the enrollment of score 73+4 tumors with varying amounts of grade 4 across studies. Intuitively, it may indeed be expected that tumors with small amounts of grade 4 (up to 20-25%) have a mean ADC value similar to that of Gleason 6 tumors, because the distribution of grade 4 components is diffuse, making thus impossible to detect an area within the tumor with a more restricted diffusion supposed to contain the Gleason grade 4 (G4) component. Moreover, between 40 and 60% of G4, evaluation of the %G4 may vary across pathologists. It can thus also be expected that, in the range of 40-60 %G4, the ADC value may not be significantly different to differentiate Gleason score 3+4 from 4+3 tumors.

In score 3 lesions, the use of ADC metrics to predict the presence signs of aggressiveness may thus be challenging. Nevertheless, it should be noted that the cancer detection rate of Gleason score >6 lesions in score 3 lesions by MR-targeted biopsies is low. It varies between 0[4] and 8.8 %[18]. Also, in our experience, the percent of Gleason grade 4 observed in score 3 cancer lesions is low, no greater than 20% at surgical histology, similar to that observed in non-visible Gleason score 3+4 tumors, characterized by a low volume and a %G4 not greater than 20%[52]. It may thus be questioned if an immediate diagnosis of these tumors is required as a radical treatment.

In one study[18], a whole-lesion ADC value at the 25th percentile ≤1.04 $x10^{-3}$ mm²/s achieved a 90% sensitivity and 50% specificity for the detection of GS > 6 tumors. In our experience, the only factor which could discriminate Gleason score 3+4 from Gleason score 3+3 tumors in score 3 lesions was the ADC ratio using the whole benign prostate as the reference ROI (0.53±0.08 vs 0.63±0.03, respectively, p=0.03) (Table 1). The Az value to detect GS 3+4 tumors was 0.8 and a cut-off value of 0.63 provided on the ROC curve a sensitivity of 80% and a specificity of 78% to predict the presence of a >0-20% grade 4 component. Values of the other factors (mean ADC, whole-lesion mean ADC value whatever the percentile, signal intensity ratio whatever the b-value) were not significantly different between both groups.

Table 2: Correlation of the %G4 component of TRUS-MRI image fusion targeted biopsies (TB%G4) with the pathological %G4 component of radical prostatectomy specimen (RP%G4) (from reference [52]). The %G4 detected on TB is upgraded to a higher rate in 15-43% of cases, depending of the %G4 category.

TB % G4 / RP % G4	0% G4 GS6	>0-25% G4 GS 3+4	>25-50% G4 GS 3+4	>50% G4 GS 4+3
0% G4 GS6	45%	4%	4%	0
>0-25% G4 GS 3+4	43%	54%	18%	0
>25-50% G4 GS 3+4	10%	27%	48%	8%
>50% G4 GS 4+3	2%	15%	30%	92%

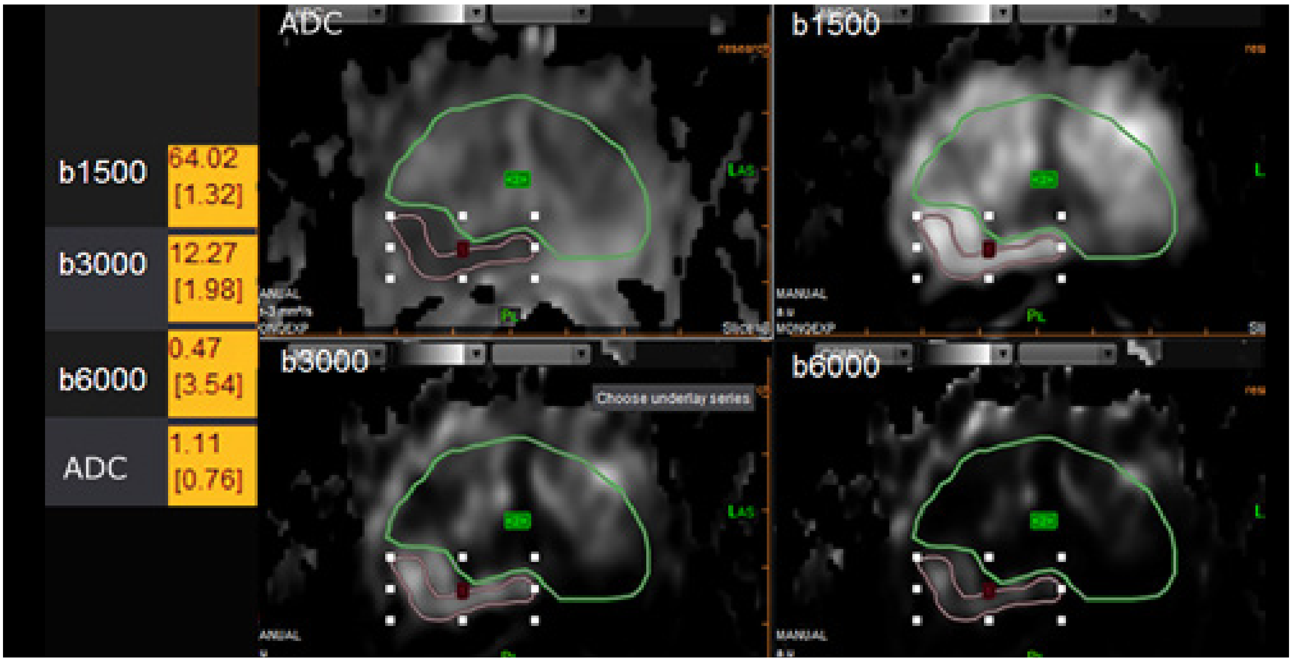

Figure 5: Signal Intensity Ratio metrics (same patient as in Figure 4). The SI ratio is of 2 at b-3000 and of 3.5 at b-6000 s/mm2, suggesting benign tissue. Note however that the value of the ADC (1.1 x10^{-3} mm2/s) and of the ADC ratio (0.76) also suggest benign tissue. Sixty template transperineal biopsies showed benign tissue.

Advanced DW-MRI techniques

Bi-exponential diffusion (IntraVoxel Incoherent Motion, IVIM) or how to separate the perfusion and the diffusion effects in DW-MRI.

In the capillary compartment of the model originally described by Le Bihan et al[54], the movement of water molecules mimics a diffusion process (pseudo-diffusion), evaluated by perfusion parameters (D*, or ADC^{fast}), derived from the weighting by several low b-values (0-100) (Figure 6). D* is represented by the initial portion of the curve which has a steep slope, because of the greater 1H2O distance motion when diffusion gradients are applied.

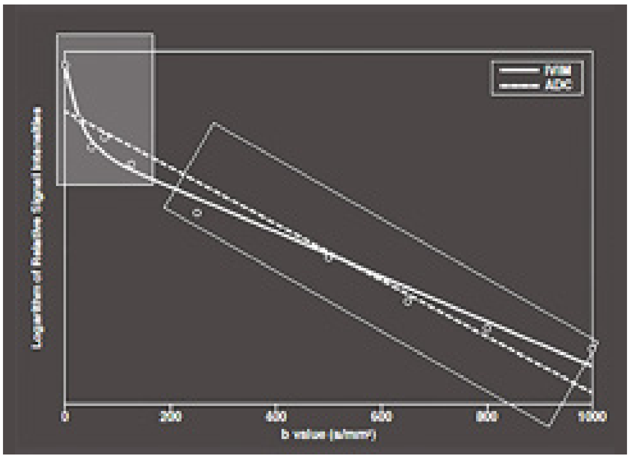

Figure 6: Bi-exponential decay of the DW signal, modified from[65]. The initial portion of the curve is steep for plotted signal intensity values at low b-values (within the rectangular light grey box). However, at higher b-values (dark grey rectangular box), the slope is less steep. The hockey stick shape of the bi-exponential curve provides a better fitting to the acquired DW data than the mono-exponential model used to generate the ADC map (dotted line).

"D has the highest accuracy to discriminate PCa from benign tissue."

The second part of the curve is evaluated with higher b-values. The slope is less steep and reflects tissue diffusion (D or ADC^{slow}). f corresponds to the blood volume derived from water protons flowing through pseudo-randomly oriented micro-capillaries and has been labelled perfusion fraction in the study by Le Bihan et al[54].
Several studies[55-59] showed that, among the three parameters (D, D* and f), D has the highest accuracy to discriminate PCa from benign tissue, but all the studies showed that D and ADC values performed equally to discriminate tumor from benign tissue (AUC: 0.9). Some studies[56,60] found that the value of D could discriminate low- (Gleason score <7) from high-grade (Gleason score >7) PCa.

The other parameters of the bi-exponential model (D* and f) showed a great variation of values with very large standard deviations and were thus not discriminant between Ca and benign tissue in all studies, but one[60]. The conclusion was that exclusion of this highly variable perfusion component may increase the diagnostic and prognostic values of the D parameter. Our experience at 1.5T with a reusable rectal coil (In Vivo) with a 10 b-values (0,10,20,30,40,50,80,100,500,1000) sequence showed that D and ADC values performed equally (AUC 0.89 and 0.91 respectively). The optimal cut-off value, regardless of the PIRADS score, to differentiate Ca from benign foci was 1070 for the ADC value (Se: 84%, Sp: 83%) and 1190 for the D value (Se: 86%, Sp: 83%).

Thus, although the bi-exponential model may provide a better fitting when multiple small b-values are used, further studies are required to confirm its potential incremental value over that of the mono-exponential model in the detection of PCa. In this regard, a study[61] showed that when measuring the whole lesion value of the ADC and that of D, D performed better, especially the 10th percentile value to differentiate GS6 tumors vs GS>6 tumors.

Kurtosis Diffusion Imaging

Overlap of quantitative ADC values derived from higher and lower grade PCa as well as from benign tissue may be due to another limitation of the mono-exponential DWI-based estimation of ADC, which assumes a Gaussian distribution of the displacements of the water molecules. However, when cellularity increases and restricts water diffusion, displacement of water molecules is assumed to become non Gaussian. The term Kurtosis describes the deviation of a non-Gaussian distribution compared with a Gaussian distribution. Using Diffusion-Kurtosis MRI (DK-MRI), it is possible to quantify this deviation. The Kurtosis is extracted from DW images acquired with a multi-b DW sequence including two b-values above 1000 s/mm² (b1500 and b2000) and may allow for a better differentiation between Ca and benign tissue. A high b-value of about 2000 s/mm² is needed to have a sufficiently large effect on the DW signal when a non Gaussian distribution is tested.

Only few clinical applications of DK-MRI of the prostate have been published. In the initial study[62], K values were higher (0.96 ± 0.24) in Ca than in benign PZ (0.57 ± 0.07) and also higher in Gleason score >6 tumors (1.05 ± 0.26) than in Gleason score 6 tumors (0.89 ± 0.20, p<.001).

The sensitivity of K was greater than that of the ADC for differentiating Ca from benign PZ (93.3% vs 78.5%, p<.001) without loss of specificity (95.7%, p>0.99) and showed a comparable value of the AUC (68.6% vs 51.0%) for differentiating Gleason score 6 tumors from Gleason score >6 tumors.

Interestingly, a second study from another group[63] did not reveal a significant difference between K and standard ADC for the detection of any cancer and of Gleason >6 tumors. The discrepancy between both studies was probably related to the ADC metrics which were extracted, in the first study[62], from the DW-Kurtosis sequence which requires an increased echo time to acquire the b-2000 images (81ms). In this second study[63] a separate standard DWI sequence was used, with a shorter TE (58ms) to calculate the ADC.

It was concluded in the second study that the value of the ADC metrics in a DK sequence may be underestimated. DK-MRI may thus show promise to improve the performance of a standard ADC map, both for diagnosis and assessment of tumor aggressiveness, but further studies are required to reconcile findings of both studies detailed above.

Conclusion

In summary, quantitative DW-MRI of the PZ may improve the specificity of DW-MRI scoring system of the PIRADS. Currently, there is not enough data to suggest that the value of the ADC metrics could be improved by more sophisticated parameters. Whole lesion ADC metrics and advanced DW sequences are under evaluation. However, they are time-consuming and labor intensive. They are thus not yet adapted for routine practice and more automatic workflows are required to incorporate them in workstations. Therefore, it seems useful to suggest simple recommendations.

The first is the use of a standardized protocol with three b-values (the high b-value should not exceed b-1000 s/mm²) and with comparable acquisition parameters across platforms. This step should aid to standardize the ADC value across centers and most probably help to better characterize score 3 or 4 prostatic PZ lesions. It may thus help the biopsy decision making in routine clinical practice in an effort to upgrade or downgrade as much as possible score 3 lesions, to switch to a binary choice which would indicate biopsy or not.

The second recommendation is the use of high and very high computed b-values which increase the conspicuity of PCa and may help to differentiate it from benign tissue. A maximal value of b-3000, if available, has been suggested (26) to visually increase the conspicuity of prostatic tumors.

"The second recommendation is the use of high and very high computed b-values."

The third is to use the rest of the benign prostate as the reference ROI, instead of the contra-lateral PZ, for ADC ratio and signal intensity ratio metrics which may improve the diagnostic accuracy of ADC metrics.

Determination of Gleason score by quantitative DWMRI should take into account the fact that the underestimation rate of Gleason score, which was a major limitation of systematic biopsies, can be considerably decreased if MR-targeted biopsies are routinely used. These biopsies still show limitations to detect small amounts of grade 4 and to accurately predict the primary Gleason grade of score 7 lesions. This information may be an important requirement before including patients in active surveillance or focal therapy protocols. The true challenge of quantitative MRI may thus be to assess if it can predict an upgrade in the %G4 detected on a MR-targeted biopsy. Further research is definitively required to determine if this goal is achievable. //

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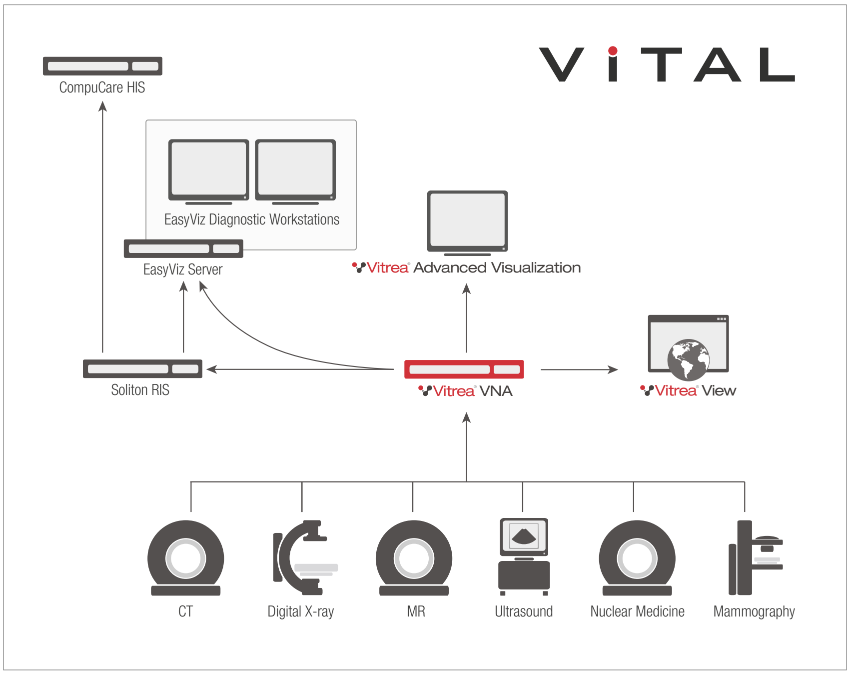
First publication in Olea Imagein,
Issue Number 2, November 2016

Deconstructing PACS – King Edward VII's key to unlocking hospital data

King Edward Vll's Hospital is a prestigious private hospital in London with a long history of providing care to the British royal family. It is the only hospital in the UK where consultants must be invited to practice. Known for its use of state-of-the-art technologies and a highly credentialed medical staff, the Hospital enjoys a reputation as the "foremost private hospital" in London.

King Edward VII's Hospital, London, United Kingdom



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The Challenge

King Edward VII's Hospital had an aging PACS that was performing poorly. The hospital was also challenged to provide uniform access to imaging in all service areas. When an upgrade was proposed by another vendor at high cost with no new functionality, leadership at the Hospital decided to consider other options.

Why Vital?

Having had a positive business relationship with Vital and Toshiba Medical in the past, King Edward VII's Hospital launched a tender process to look at alternatives to the current vendor. After careful review, IT, medical and administrative staff all selected Vital.

Implementation

King Edward VII's Hospital outlined requirements that included a timeline for project completion within three months. The Hospital set up a dedicated team of clinical and IT resources to direct the implementation of Vitrea® Health Imaging Informatics products into their clinical informatics structure. Vital dedicated a team of software engineers and professional services staff to provide environmental set up, configuration and workflow integration.

Project tasks completed by Vital

- Project planning
- New IT infrastructure built
- New radiology information system (RIS) installed
- Migration from legacy PACS
- New vendor-neutral archive (VNA), enterprise viewer, diagnostic viewer
- Integration with hospital systems
- Staff training and go-live

Components:

- Vitrea Advanced Visualization
- EasyViz Diagnostic Viewer
- Virtea Enterprise Viewer
- Vitrea Data Stream
- Vitrea Vendor-Neutral Archive

References

- Corey Frazer, Manager, Imaging Services

"The project went really well. The Vital team are brilliant to work with! It is a pleasure to be involved with a highly motivated, forward-thinking group with a can-do attitude."

Corey Frazer
Manager | Imaging Services
King Edward VII's Hospital


Dr. Martin Fähndrich
Head of interventional endoscopy

We Benefit from the High Resolution and from the Many Opportunities to Reduce Radiation

Consultant Dr. Martin Fähndrich is the doctor in charge of interventional endoscopy at the largest hospital in the German state of North Rhine-Westphalia. Around 8,000 endoscopies are carried out in his department each year. Toshiba Medical's Ultimax™-i is used predominantly when additional imaging information is required, alongside the endoscopic image. One further advantage is that several planes can be superimposed using the multifunctional X-ray system. This means that changes in the bile ducts, for instance, can be visualised with more complexity and are therefore treated endoscopically better and more quickly than before.

What is your clinical daily routine like and which patients do you treat?
Interventional endoscopy represents a key focus of my activity. Thanks to the development of new technologies and processes, endoscopy has become increasingly important in recent years in the treatment of diseases that were previously treated with surgery. The minimally invasive procedure in particular is very popular with patients due to the low degree of trauma, and is therefore viewed very positively. But it is not just in primary treatment that our services are required; other key aspects are perioperative investigations and postoperative management of complications, such as in the treatment of insufficiencies and fistulas, for example.

Which particular examinations do you carry out in the Gastroenterology Department using Toshiba Medical's Ultimax-i?
We generally use fluoroscopy when additional imaging information is required, alongside the endoscopic image. This can be necessary in the event of dilatations, stenting or treatment of fistulas, and can go as far as complex necrosectomies or cholangioscopies, whereby the most common examination is still the conventional therapeutic endoscopic retrograde cholangiopancreatography (ERCP). However, we also perform percutaneous procedures such as portal venous pressure measurements, transjugular liver biopsies or percutaneous transhepatic cholangiography drainages (PTCD).

“We benefit not only from the high resolution and excellent imaging quality, but also from the many technical opportunities and settings to reduce radiation. Because of this, we can work with as little radiation as possible, and still obtain good images.”

Despite the availability of alternative procedures, these are still required in certain cases. Because of advancements in the fluoroscopy equipment used in endoscopy, we are able to exploit the advantages of fluoroscopy in a very flexible manner, in accordance with the indications and particular situation at hand.

You have been working with the Ultimax-i in your department for approximately one year. In your opinion, what are the particular strengths of this multifunctional X-ray system?

The angiography option is a major advantage for us. As gastroenterologists, we certainly do not take it for granted that we will be able to work with systems that offer multiple planes. We benefit not only from the high resolution and excellent imaging quality, but also from the many technical opportunities and settings to reduce radiation. Because of this, we can work with as little radiation as possible, and still obtain good images. Flexibility and good access to the patient are of fundamental importance for our procedures. The table and pipes in the Ultimax-i can be moved in all directions and positioned well.

What has actually changed in your job since you started using the Ultimax-i? Can you now offer different examinations compared to before?

Previously, we only used one undertable device and could not superimpose multiple planes. Now, we can visualise bile duct changes, for instance, with more complexity in multiple planes, and we can also treat these endoscopically better and more quickly. Thanks to this new system, the quality of our examinations has improved. But we don’t offer a different range of examinations through this.

Are you satisfied with the quality of the images and has the system fulfilled your expectations on the whole?

The fluoroscopic images are very good. The settings of the Ultimax-i can be adjusted to the specific needs of the situation. We are also very pleased with the high spatial resolution. Thanks to the numerous possibilities for customised adjustment and image processing, we can achieve an optimal level of flexibility and as I mentioned before, above all, we can work with very little radiation.

Gastroenterology at Klinikum Dortmund:

- *Klinikum Dortmund is the largest hospital in the German state of North Rhine-Westphalia. Every year, more than 245,000 patients (65,000 inpatients, 180,000 outpatients) from the region and surrounding federal territory are treated there.*

- *The hospital, which provides the highest level of medical care, has 1,422 beds. Around 4,000 employees (including 565 doctors and 1,290 nursing staff) look after the patients.*

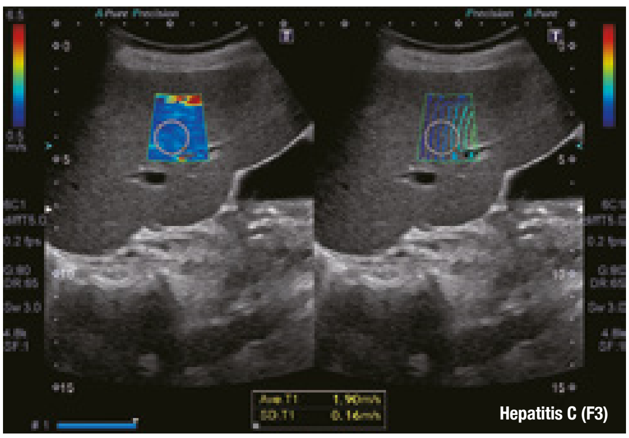
- *The focus of the Medical Clinic in the Department of Gastroenterology lies on the investigation and treatment of gastrointestinal and hepatobiliary tumours, pre-cancerous diseases and non-cancerous diseases such as gastrointestinal bleeding, acute and chronic pancreatitis, viral, toxic and immunological liver inflammations, liver cirrhosis, biliary tract diseases, bile duct stones, chronic inflammatory bowel diseases and diverticulitis.*

Ultimax-i

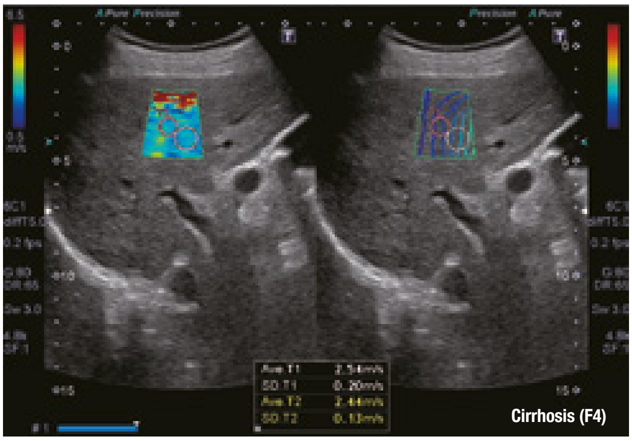
Shear wave on Xario 200:

Bringing shear wave into routine clinical practice

Shear wave elastography is nowadays a widely accepted method to diagnose diseases based on measuring tissue stiffness. To allow more clinicians and patients to benefit from this advanced ultrasound technology, shear wave is now available on Xario 200 Platinum Series, a small but extremely versatile diagnostic ultrasound solution. Unique smart maps provide highly intuitive workflow in obtaining accurate shear wave measurements, which are essential to make a confident diagnosis. Reliability and ease of use make our shear wave elastography a suitable tool for your daily routine exams.



Hepatitis C (F3)



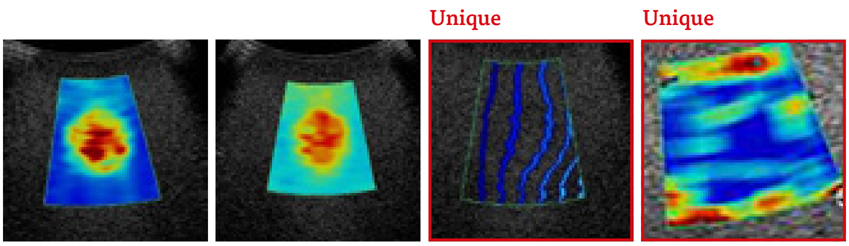
Shear wave elastography

Shear wave technology provides a quantitative measure and dynamic visual display of tissue stiffness in abdominal examinations. This highly accurate and reproducible tool provides fully integrated measurement and reporting for seamless integration into your clinical workflow.

Smart maps

Smart maps allow you to visualize shear wave propagation in a user-defined region of interest in real-time. The user can select both dynamic propagation speed and elasticity displays for visual assessment and quantification.

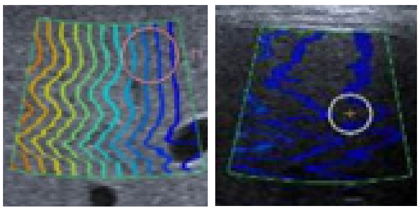
Xario provides you with various smart maps to enhance workflow by guiding you in obtaining robust measurement results.



Speed [m/s] | *Elasticity [kPa]* | *Propagation map* (*Arrival time contour*) | *Variance map* (*2D presentation of propagation*)

Propagation map

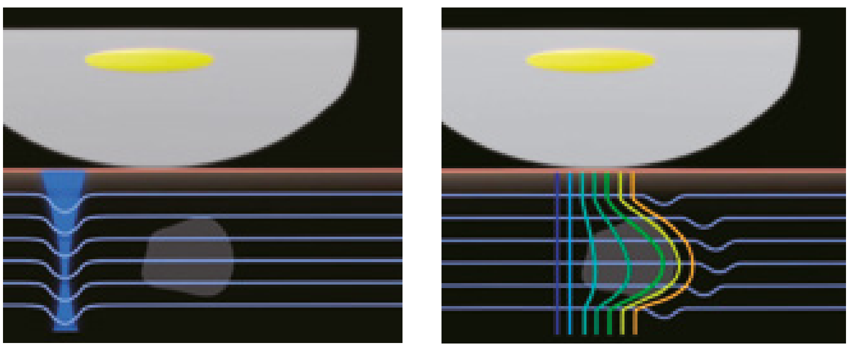
The unique propagation map is a powerful and intuitive tool to visually assess the quality of an elastogram. Areas with distorted or absent shear wave propagation are easily recognized by means of a disrupted wave front.
Areas with parallel lines indicate reliable locations for collecting accurate and reproducible data. The distance between the propagation lines is also a reference for tissue stiffness.



Good Acquisition | *Poor Acquisition*

The principle behind shear wave elastography

Shear waves are generated inside the human body by means of an ultrasonic push pulse (left). Depending on tissue stiffness, shear waves travel at a varying speed, through the human body. Their propagation can be followed and visualized using conventional ultrasound imaging techniques (right). The propagation speed of the shear waves directly correlates with tissue stiffness.



Vantage Titan 3T -

Pushing the Boundaries in Neurovascular Imaging

Dr. Andreas Schilling

Dr. Andreas Schilling is Head of the Radiology Department at Klinikum Frankfurt (Oder, Germany). Together with his team, he is exploring new avenues in the treatment of arteriovenous malformations.

More than 75,000 patients from Frankfurt (Oder) and its region are treated in the Klinikum. The treatment of vascular diseases in the brain, as well as tumorous diseases and injuries in the brain, are specialist fields for the clinic. There are only a handful specialized centres for this specific disease field. Since October 2015, Klinikum Frankfurt has been the only hospital in Germany to have a Toshiba Medical Vantage Titan™ 3T MRI Scanner. The device is used by the hospital primarily to investigate cerebral arteriovenous malformations. Thanks to three-dimensional depiction and visibility in layers over the course of time, possible with the Vantage Titan 3T, traditional angiography via X-ray images will be replaced in the future . The overall advantage is the reduction of radiation load to zero, also the intervention has fewer risks and the MRI Images show the surrounding brain tissue.

MRI scans are predominantly used as an additional source of information in the diagnosis of arteriovenous malformations (i.e. short circuits, as it could be envisaged, between arteries and veins that may lead to epilepsy or hemorrhages, amongst other things). The traditional X-ray angiography is still the gold standard. The reason for this is that it has not been possible to date to obtain adequate information from the MRI regarding perfusion of the arteries. "The image acquisition speed in a standard MRI is not fast enough," explained Radiologist, Dr. Andreas Schilling. "Being able to see the flow velocity effectively in the moving image, however, is exceptionally important for me. I need to know whether I have successfully reduced the blood flow as a result of an intervention, and whether the patient is safe from a risk of hemorrhage." On the other hand, MRI scans also have a significant advantage over traditional angiography with X-ray imaging. They enable us to easily obtain a three-dimensional layer model of vascular changes in the brain, even without contrast medium, which is required in X-ray imaging. Three-dimensional visualisation is a huge help, as vascular changes often appear as unclear knots of arteries.

Dr. Schilling has been using a Vantage Titan 3T in his clinic since last summer. "We have selected a Toshiba Medical MRI system, as this system is optimized for the depiction of vessels. This is a natural fit for a clinic such as ours with a neurovascular specialism," he explained. His goal is to switch to MRI entirely in the future, not just for diagnosis and treatment planning, but also for real-time imaging during surgery. "At the moment, we stand at an image per second in an MRI, using the best technology that is currently on the market. In the X-ray procedure, it is six images per second. We need a spatial resolution of at least half a millimeter for six images per second. Today, the MRI gives us an accuracy of two millimeters with an image speed of one image per second."

In consultation with the developers at Toshiba Medical, Dr. Andreas Schilling and his team are working on gradually improving the vascular MRI sequences. "We explain our requirements to the developpers and they explain what is possible at this moment in time. On a regular base we receive updates based on our requirements." Optimisation occurs entirely at software level. "There is actually nothing more in terms of hardware that we could purchase," said Dr. Schilling.

From a purely practical point of view, the treatment of arteriovenous malformations using the MRI scanner would be entirely possible. When the patient's head is placed in the center of the magnet, the groin still protrudes. The catheter through which the procedure in the brain is carried out is inserted here. Obviously there are problems that still need to be solved. Dr. Schilling explained: "We currently use a small gold ring as marking for the microcatheter. And to bring the catheter in to where it should be, we use a guide

Figure 1: MR axial T2 and MRA of the head.

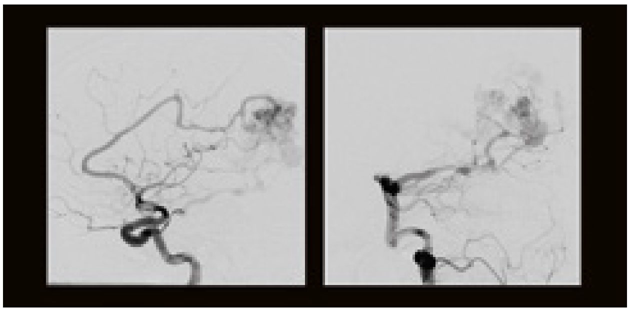


Figure 2: Conventional angiography of an AVM.

Dr. Andreas Schilling.

wire. Both of these would lead to artefacts in an MRI. All that would have to be rethought, but I feel that it is feasible."

A significant advantage of switching from X-ray to MRI would be the discontinuation of exposure to radiation. This would not only benefit the patients, but also the doctors, who currently have to be clothed entirely in lead during the procedure. More importantly, MR angiography also shows brain tissue, contrary to X-ray imaging. It is possible to monitor how the brain reacts to an intervention in real time using MRI – something that at the moment can only be determined retrospectively in follow-up examinations. "We would also be better able to see if a microcatheter inadvertently damages a vessel wall and causes bleeding. In that case, I would know that I need to close it quickly, or even operate in an emergency. Or, if allergic reactions occur, medication can be administered to counteract them," explains Dr. Schilling.

Another hurdle that must be overcome during the intervention is the precise application of the adhesive with which the misdirecting artery is to be closed. The procedure has to be planned accurately so that the efferent vein is not bonded and the adhesive does not harden before it arrives at the correct position. In practical terms, this means that the adhesive mixture must be adapted to the flow velocity of the blood in the affected artery. Currently, we have to settle more or less for estimates. "However you could take objective flow measurements with an MRI," reasons Dr. Schilling said.

This is not all a dream for the future. Dr. Schilling and his team are already using MRI now to reduce the amount of X-ray imaging. On the MRI Image the pathway for the contrast agent filled catheter can be detected easily and transfered to the X-ray. In an ideal scenario, you would only have to produce an X-ray image of the area of interest, and, would not have to first treat the surrounding vessels with a contrast medium and then X-ray them. "We currently still use traditional angiography in the surrounding areas. It can still happen that a turbulent flow in a vessel leads to the effect on the MRI image that the vessel is depicted to be thinner than it really is. However, these phenomena are well known and not surprises for us," explained Dr. Schilling.

Treatment under MRI monitoring would also be interesting for another clinical picture: aneurysmal bleeding. Three to four in every 100,000 people have an arteriovenous malformation (which is often not abnormal). Around 100 patients with arteriovenous malformation are treated annually in Frankfurt (Oder). An enlargement in the artery in the form of an aneurysm, however, is present in 8% of all people. One in ten cases leads to bleeding. That is 800 cases in a population of 100,000 people. A common treatment in the case of aneurysmal bleeding is what is called coiling: filling of the pathological bulge in the arterial wall with platinum spirals.

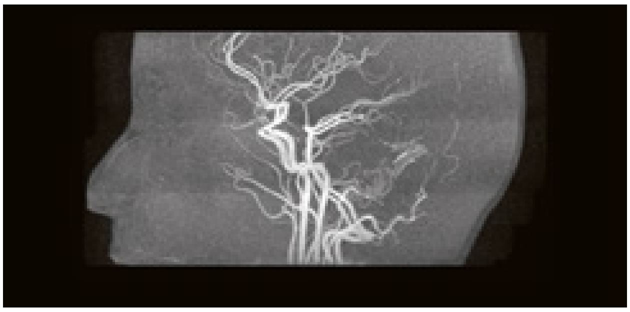


Figure 3: MRA of the head - diagnosis. Previous embolisation.

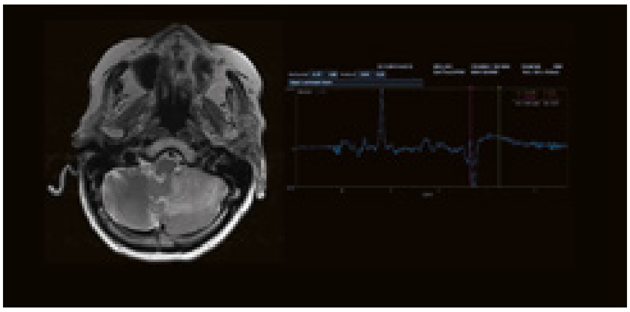


Figure 4: Spectroscopy.

During an intervention such as this, good spatial resolution in the imaging is required above everything else. The temporal sequencing is not so critical. Dr. Schilling believes that, in five years' time, MRI will be developed enough to replace X-ray imaging during coiling.

In addition to depiction over time, the Vantage Titan 3T facilitates an additional diagnostic process used in Frankfurt (Oder): Magnetic Resonance Spectroscopy (MRS). "Instead of generating an image of brain structures, you can also easily measure how frequently specific types of molecules that are involved in metabolism occur in the brain," explains Dr. Schilling. It is often not possible to detect if an abnormality involves an inflammation, an infarction or something else, using angiography alone. Using the molecular markers, however, it can be decided whether the tissue is, for example, inflamed, or whether there is a tumor, and if this is benign or malignant and slow- or fast-growing.

"A creatinine peak, for example, indicates high cell division activity. A reduced choline level indicates a low energy level. N-acetylaspartate shows how much brain tissue is present. Lactate and lipid peaks indicate pathological symptoms."

The analysis procedure can be carried out for individual areas of the brain separately. "If there is a structure in the brain and I do not know what it is, that can be very helpful. I can help the neurosurgeons taking a sample at the best position: Better look to the front instead of the back, it looks more conspicuous. Or if there is a patient with symptoms of a stroke, who is actually too young to have a stroke. The spectroscopy provides indices if tumourcells are involved." The follow-up check after doses of radiotherapy is another possible application. Areas of inflammation or pseudo progression, which may occur following the treatment, cannot be diagnosed clearly by means of imaging. Magnetic Resonance Spectroscopy ultimately cannot fully replace other diagnostic procedures. However, like MR Angiography, it provides additional information in order to better plan invasive or radiation-intensive procedures in the diagnosis and treatment and, enable their reduction. //

Dr. Andreas Schilling
Head of the Radiology Department in Klinikum Frankfurt (Oder) Germany.

General guidelines for authors

Works are generally classified into two categories: Full length articles (e.g. clinical added value of new/special applications & technologies) and Short contributions (e.g. system testimonials, case reports, technical notes).

All articles should be double-spaced.

Full length articles
Full length articles should generally include the following:
- Author's full name and highest academic degree, employer medical institution
- Author's biography (150 words)
- Author's passport-size photograph (suitable for publication); (image of 300 dpi)
- 200-word abstract
- Text including headline, sub-title, introduction and sections like: materials & methods (which should include a full description of equipment used), results, discussion and references
- Text approx 4 to 5 pages or 12.000 to 14.000 characters (not including figures, tables and photographs)
- Correspondence address
- Literature (no more than 10 references)
- Separate, continuous numbered image- and table captions

Short contributions
Short contributions should generally include the following:
- Author's full name and highest academic degree
- Author's employer medical institution
- Author's biography (150 words)
- Author's passport-size photograph (suitable for publication); (image of 300 dpi)
- Text including headline, sub-title, introduction and full description of methods & materials/equipment used
- Case Report or description of system improvements (Technical Notes)
- Correspondence address
- Literature (no more than 10 references)
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Text
The article should be saved in Microsoft Word (PC format) if possible, and, if not, in text only.

Please indicate the software program and version used (Microsoft Word 2007, etc.) and whether it is a PC or Macintosh formatted document. If e-mailing, make sure to send it as an attachment, rather than embedded in the e-mail message.

Symbols, formulas and abbreviations
Symbols, Greek letters superscripts/Subscripts must to be identified clearly. Furthermore, the figure 1 (one) and the letter l (el) as well as the capital letter O and the figure 0 (zero) should be easy to differentiate.

All abbreviations including units of measure, chemical names, technical or medical acronyms, names of organisations or institutions should be defined when they first appear in the text (e.g. congestive heart failure (CHF). Please refrain from using unfamiliar abbreviations, clinical slang or jargon.

Images, art and tables
Cite all figures and tables in text, preferably in consecutive order. Please include a caption for each figure. All captions for each figure, should be separate from the text, at the end of the manuscript on a separate page. Captions should avoid duplication of text material. Credit lines for artwork can appear at the end of the corresponding caption by stating: (Provided by first initial, last name). Black out (or give clear instructions which parts should be blackened out) of the images to not violate any data protection regulations (e.g. patient data)

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Authors should indicate if they would like to have artwork returned.

Each table should have a title, and all abbreviations should be spelled out or explained in a footnote.

Style
Title page should include full names, degrees and titles of authors, and affiliations (name of institution, city and state) for use in a by-line, as well as phone and fax numbers to facilitate sending edited copy back to author for approval.

Define all symbols, abbreviations and acronyms on first reference.

All manuscripts should be written in a third-person style, unless the article is specifically an editorial or first-hand review.

References
A maximum of 10 references is suggested. Complete references should be listed in order of citation in text, NOT alphabetically. Up to four authors will be listed; if there are five or more authors, only the first three will be listed, followed by et al. Within the text, reference numbers should appear as footnotes in parentheses or in superscript text at the end of each appropriate citation. Please do not use Microsoft Words endnote feature, as this causes major problems in the editing phase.

In addition, if the reference is not in English, please indicate the language of publication.

Journal example
Oberhaensli RD, Galloway GJ, Hilton-Jones D, et al. The study of human organs by phosphorus-31 topical magnetic resonance spectroscopy. Br J Radiol 1987;60:367-373

Book example
Welch KMA, Barkley GL. Biochemistry and pharmacology of cerebral ischemia. In: Barnett JHM, Stein BM, Mohr JP, Yatsu FM, eds. Stroke: pathophysiology, diagnosis and management. New York: Churchill Livingstone, 1986;75-90.