Infinix-i Rite Edition
Exercise Myocardial Performance in Adolescent Athletes
Clinical Added Value of Volume CT

VISIONS
Magazine for Medical & Health Professionals | August 2016

State-of-the-Art Post-Processing & 3D Visualization Applications

"The best way to predict the future is to create it." - Abraham Smards
The ‘made for life’ philosophy prevails as Toshiba Medical’s ongoing commitment to humanity. Read more on page 18.

General guidelines for authors

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

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 peer-reviewed 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 to 5 pages or 12,000 to 14,000 characters
  - 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 peer-reviewed photograph (suitable for publication), (image of 300 dpi)
  - Text including headline, sub-title, introduction and full description of materials & materials/equipment used
  - Case Report or description of system improvements (Technical Notes)
  - Correspondence address
  - Literature (no more than 10 references)

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 B or 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), photochemotherapy or computerized axial tomography CT).
- Abbreviations and acronyms should be defined clearly. Furthermore, the figure 1 (one) and the letter l (el) as well as the capital letter B or 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

- 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 manuscript on a separate page. Captions should avoid duplication of test 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).
- Do not embed figures, charts, or graphs into your document file. Please provide them as a separate file, as well as in hard copy or corrected pdf file. Please use one of the following formats: EPS, TIF or JPEG. Arrows stuck onto images for purposes of delineation should be clearly visible and reproducible.
- 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

- All 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. After 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.

Book example:


Journal example:


Book example:

While working hard to get this 27th edition of VISIONS magazine to print, the countdown to the Summer Olympic Games, in Rio de Janeiro, Brazil, runs quietly in the background. Still 15 days, 17 hours, 25 min and 36 seconds to go, as I write this text, before the official opening ceremony will start.

The modern Olympic Games are the leading international sporting event featuring Summer- and Winter sports competitions, in which thousands of athletes from around the world participate in a variety of competitions. The Olympic Games are considered to be the world’s foremost sports competition, with more than 206 nations participating.

Country teams and individual athletes from all over the world have been preparing, physically and mentally for this event, for months in advance. Training hard, scrutinizing their nutrition and ensuring that they get enough rest. All to reach peak condition to enable them to give their best, and, hopefully, an ultimate sports performance.

Taking part in the games should not be taken lightly. “You need to have guts when you’re up against it. You need a dream, a goal, and above all, your family,” commented Oscar Figueroa on participating in the Olympic Games himself. In itself, this is quite true, but I would like to add that professional, medical counseling and monitoring are also indispensable requirements to reach the highest goals.

Toshiba is proud to be a leading imaging expert that is heavily involved in and contributes to the optimal health condition of athletes. Renowned football clubs, such as Manchester United, FC Barcelona, Inter Milan and AS Monaco, use Toshiba equipment and systems to keep their players in optimal condition. It is not a coincidence that you will find several articles in this edition of VISIONS magazine that reflect our knowledge, experience and expertise in the field of sports medicine.

I say: "Let the games begin!"

PS: did you know we also host a VISIONS Magazine LinkedIn Group? Feel free to join us!
https://www.linkedin.com/groups/3698045

Kind regards,

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

1 Wikipedia: The Free Encyclopedia
2 Weightlifting - London 2012 Olympic silver medal winner for Colombia
The world's fastest and most flexible angio suite; the Infinix-i Rite Edition.

Dr. Subhash Srivastava, Radiologist specialized in cardiovascular diagnostics at the Karolinska University Hospital.

At Toshiba Medical, everything we do is made for life.

Karolinska University Hospital invests in TAVI examination

Managed Equipment Services

The Future of Ultrasound - Shaped by Fifty Years of Heritage

Hyaluronic acid protection of cartilage

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52 TAVI is used to treat aortic stenosis; the most common heart valve disease in the Western World.
TMVS wins ‘Made in Scotland - Life Sciences Company of the Year’ Award.

Malcolm Campbell, Vice President Engineering of Toshiba Medical Visualization Systems, picked up the coveted award that recognises the ability to innovation and the contribution TMVS made in the life sciences market in the last year. Examples of these contributions are: Ultrasound luminance, MR Core imaging, Adaptive Motion Correction and Cardiac Subtraction. All technologies that have found their way to Toshiba’s global product portfolio.

Harefield Hospital partners with Toshiba

Toshiba announced the design of a new cath lab at Harefield Hospital, the largest heart and lung centre in the United Kingdom. The Toshiba Infinix-i™ cardiac catheterisation laboratory (Cath Lab) is unique due to the range of movements that the equipment can make around the patient, these unique movements enable the Cardiologist to operate without moving the patient on the treatment table which contributes to a make procedures quicker, safer and more efficient.

The Hospital’s dedicated heart attack centre deals with acute and immediate emergencies from outer north-west London, providing primary angioplasty in its four specialist catheter laboratories with the Toshiba Infinix-i being the latest. Its arrival-to-treatment time of 26 minutes is one of the fastest in Europe: speed of treatment has been shown to be crucial to survival in such cases.

Mark Bowers, Cardiology Service Manager at Harefield Hospital comments: ‘The project management from design to installation was world class. By using Toshiba’s augmented reality planning tool, we were able to produce a truly collaborative design that allowed the team at Harefield team to feed into and agree design ahead of build.’

Mark Hitchman, UK Managing Director for Toshiba Medical Systems comments: ‘The Cath lab design and installation at Harefield is a testament to Toshiba’s philosophy of partnering with clinicians to develop innovative facilities, situated within an inspirationally designed space that enhances their ability to provide fast, efficient and effective care for their patients’.

myWobble: a mobile platform for managing genetic data

The myWobble app transforms genetic data to easy-to-interpret and visualized information for people with or without a science background. Users can learn about their health profile, ancestry, how they might react to pharmaceutical drugs and which genetic marks cause their physical features. Users can enjoy the app while their genetic data remains private and stored solely on their own mobile device. myWobble is available on iTunes for $ 9.99 on iPhone and iPad and enables the personalgenomics revolution today.

Video: https://vimeo.com/103711315

FC Barcelona unveils one of the most powerful magnetic resonance systems on the market

The FC Barcelona Medical Centre has, as a result of its agreement with Toshiba Medical Systems Europe, some of the finest technology in the field of sports diagnosis. And now the facilities went one step further with the installation of a 3 Tesla nuclear magnetic resonance machine, the most powerful device produced by the Japanese medical technology firm. It will be used to diagnose muscle and bone injuries in athletes at greater speed and accuracy levels than ever.
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Playing sports at the highest levels increases the chance of injuries, as the body is pushed to its limits, and sometimes beyond. High quality imaging can play a key role in managing the training and treatment of top athletes through optimization of training schedules and injury prevention, as well as revalidation after injury.

Specialists from all over Europe with an interest in top level sports were gathered to discuss this topic and were able to explore advanced MRI techniques in musculoskeletal imaging at Toshiba’s European MRI User meeting. The event was held at the stadium of one of Europe’s top professional football clubs, FC Barcelona, in Barcelona, Spain. The meeting was organized by Toshiba in collaboration with the Clinica Creu Blanca Medical Center in Barcelona and Olea Medical – providers of advanced MRI and CT post-processing and visualization solutions.

Speakers at the event included a variety of researchers, radiologists and technicians, who shared results they have achieved in this field with Toshiba MRI systems and Olea Medical’s advanced software.

Decision-Making Based on Precise Results
Dr. Canal, Chief Medical Officer of FC Barcelona, pointed out the importance of advanced imaging techniques in his daily practice of managing treatment and training of top athletes. He explained the background of decision-making based on medical imaging. One of the physicians of the FC Barcelona Medical Team, Dr. Til, showed the results of MRI examinations on cartilage problems sometimes experienced by players.

Dr. Blasi from the University of Barcelona presented on the anatomy and histology of cartilage, muscles and tendons. To get the best views of these tissues, correct imaging protocols are crucial. Mrs. Ferrer, Radiographer at Clinica Creu Blanca Medical Center, and Mrs. Fernandes, from Toshiba Medical Systems in Spain, showed an extensive overview of optimal MRI techniques, pinpointing important issues with regard to optimizing 3D imaging.

Measuring the Impact of Top Sport
The effect of top sports on cartilage and the chondral charge was explained by Professor Gold from Stanford University, California, US. Dr. Bossy, from the Clinica Creu Blanca Medical Center, focused on muscle and tendon injuries and emphasized the importance of identifying the function of each muscle and tendon with regard to the total support structure. To explore the internal structure of peripheral nerves, Dr. Lefebvre, from Lille University Hospital, in France, showed high level diffusion images with tensor reconstruction.

Dr. Padrón, from the Clinical Centro, Madrid, in Spain, presented interesting cases on chondral and osteochondral injuries. The advanced diagnosis using quantitative imaging techniques showed that MRI is increasingly emerging from a qualitative technique towards quantifiable data that can easily be compared in follow-up examinations. From chondral pathology a small step was made into MR Hip imaging by Dr. Cerezal from Clinica Diagnostico.
Medico Cantabria, Santander, Mexico. Dr. Cerezal, who is an expert in hip pathology, shared a large variety of hip pathologies visualized with MRI.

Muscle and tendon injuries were also explored in the event. While Dr. Blasi from the University of Barcelona, explained the anatomy and histology of these important structures, Dr. Teixeira from the University of Nancy, in France, demonstrated how advanced imaging techniques can be used to observe all the features and characteristics of muscles and tendons.

**Access to Advanced Knowledge**
Through user meetings, Toshiba aims to provide its customers with direct access to specialists with experience in advanced techniques and applications of Toshiba’s technology that might be valuable in their own work.

**Assessing Athletic Potential**
Professor Derave from Ghent University, in Belgium, presented a novel Muscle Talent Scan Project. The ratio between different muscle types and their abundance is unique to the performance potential of an athlete in a specific sport. A 20 minute MRS scan can reveal the potential of an athlete. In addition, optimization of training schemes based on this knowledge could play a crucial role in injury prevention.

Professor Gold Stanford University, California, US, also explored muscle velocity and the use of phase contrast to measure this.

**Fusion Techniques**
Dr. Til also demonstrated the technique of fusion MRI and Ultrasound modalities. Whereas problems are encountered in Ultrasound due to limits to penetration depth caused by shading, the same is not incurred in MRI. However, MRI takes more time and is less easily available. Through synchronized fusion of the images during live ultrasound scans, the operator can benefit from the best of both worlds, as demonstrated in a live demonstration.
REVOLUTIONISE INTERVENTION

One Room. One System. One Procedure.

Toshiba’s ground-breaking new Infinix 4DCT 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.

Infinix 4DCT
SEE. DIAGNOSE. TREAT.
Recently Toshiba announced a strategic partnership with The Advanced Wellbeing Research Centre in Sheffield, United Kingdom. The partnership will see Toshiba providing state-of-the-art diagnostic imaging equipment and wearable biosensors as well as ongoing consultancy with regard to application innovation and development for AWRC applied research.

Much of the research expertise will come from research teams that helped the Great Brittan Olympic Team achieve 24 medals in London 2012 and will integrate into the National Centre for Sport and Exercise Medicine that seeks to improve people’s lives through physical activity.

Toshiba will also supply World class diagnostic imaging equipment including its Aquilion ONE™ dynamic volume CT system, which will allow researchers to successfully collect images of athletes’ and patients’ entire organs in one rotation. The imaging equipment comes with dynamic volumetric acquisition protocols that can be used to review moving joint structures in 3D, as well as dynamic blood or air flow that will see Toshiba consultants partnering with AWRC researchers to develop applications and best practice guidelines regarding the early diagnosis, improved rehabilitation and preventative care for those that are exercising both at elite athlete level and for the local community and wider public.

Professor Steve Haake, AWRC Director, comments: “We are delighted that Toshiba has become AWRC’s first industry partner joining Government’s backing. Media articles about overweight children, rising levels of obesity and diabetes appear in a newspaper almost every day. Most recently the World Health Organisation reported that nearly three quarters of men and two thirds of women in the United Kingdom will be overweight by 20201. That’s less than 5 years away!

“Sedentary behaviour and a stream of rich food can lead to all sorts of problems appearing in our lives as chronic disease. This was highlighted by a 2011 report for the Department of Health, which showed that increasing physical activity could reduce the risk of type II diabetes and colon cancer by up to 50%, heart disease and stroke by up to 35%, depression by 30% and the other scourge of our day, Alzheimer’s disease, by 30%2.”

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Left to right: David Hobson - Chief Executive Legacy Park Ltd, Jane Ellison MP - Minister for Public Health, Mark Hitchman - Managing Director Toshiba Medical Systems UK, Graham Moore - Westfield Health Chairman, Rt Hon Richard Caborn - Project Lead Legacy Park Ltd, Professor Steve Haake - AWRC Director, Professor Karen Bryan - Pro Vice-Chancellor and Dean of the Faculty of Health and Wellbeing at Sheffield Hallam University, Professor Paul Harrison - Pro Vice- Chancellor for Research and innovation at Sheffield Hallam University.
"With these statistics and predictions in mind, the Advanced Wellbeing Research Centre has been set up to become the most advanced research and development centre for physical activity in the world, creating ‘innovations that help people move’ in sport, healthcare, physical activity and leisure.'

Acting as a hothouse of innovation, the AWRC will bring together a set of industry partners who manufacture and supply technology and equipment including apps, activity loggers, sports equipment, orthotics, and clinical devices. The main focus of the AWRC research and innovation will be on how technology is used, how people interact with technology that helps them become more physically active, and how improvements in physical health are captured and monitored in order to provide an evidence base regarding the positive impact of physical activity on health.

Projects will aim to find out what works in large populations, initially using the population of Sheffield as a field laboratory. Additionally, the AWRC is set to become a critical assistance partner for the National Health Service by providing an evidence base that proves the positive impact of exercise on the health of the population in the United Kingdom.

Mark Hitchman, Toshiba Medical Systems’ UK Managing Director comments: "Our partnership with AWRC forms a critical part of Toshiba’s strategy to invest and partner in research projects that will have considerable benefits to NHS efforts and the population in the United Kingdom at large.

"AWRC will target wide swathes of the population, from those who are completely sedentary to those who are most active; from young to old; from those in the most deprived communities to those in the most affluent; from those at home to those in work, in education or in elite sport.

"Toshiba’s imaging equipment and exercise monitors will play a crucial role in identifying and understanding the positive effects of exercise on health, whilst helping to provide accurate diagnoses and recovery paths for those that are injured."

As well as the AWRC, Toshiba’s radiology equipment is powering not just some of the leading medical institutions, but also some of the world’s leading sports organisations and community-based sports facilities such as Manchester United Football Club, FC Barcelona, Barnet Football Club, The Tessa Sanderson Foundation and Academy and the recently held 2014 Glasgow Commonwealth Games.

Mark Hitchman - Managing Director, Toshiba Medical Systems UK (left) and Professor Steve Haake - AWRC Director (right)

References

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’s systems are installed by Toshiba and its customers. Not the actual imaging products but photos of sceneries, cities, countries or other cultural aspects are highlighted on this photo page.

Every reader of VISIONS can participate and get their picture published. The submitted content should include: high resolution (300dpi) image, photo of the hospital and a brief text, name of photographer and Toshiba system(s) installed. The complete result is shown on the opposite page.

Send your pictures and texts to: jack.hoogendoorn@toshiba-medical.eu, Subject: Photo Page
The Leibniz Institute for Zoo and Wildlife Research (IZW) is an internationally renowned research institute of the Leibniz Association. With the mission of “understanding and improving adaptability” it examines evolutionary adaptations of wildlife and its resilience to global change, and develops new concepts and measures for conservation. To achieve this, the IZW uses its broad interdisciplinary expertise in evolutionary ecology and genetics, wildlife diseases, reproductive biology and management in a close dialogue with stakeholders and the public.

Web: www.leibniz-izw.de - Text & photography: Steven Seet

The tiger (Panthera tigris) is the largest cat species, most recognisable for their pattern of dark vertical stripes on reddish-orange fur with a lighter underside. The largest tigers have reached a total body length of up to 3.38 m (11.1 ft) over curves and have weighed up to 388.7 kg (857 lb) in the wild. The species is classified in the genus Panthera with the lion, leopard, jaguar and snow leopard. Tigers are apex predators, primarily preying on ungulates such as deer and bovids. They are territorial and generally solitary but social animals, often requiring large contiguous areas of habitat that support their prey requirements.

Infinix-i Rite Edition
– 3D Anywhere in Angiography
The world’s fastest, most flexible angio suite

Around the world, providers of Interventional systems are being challenged to improve ergonomics, patient comfort and dose efficiency while at the same time reducing the cost of ownership and environmental impact.
By fulfilling all these demands Toshiba is proud to introduce the world’s fastest and most flexible angio suite; the Infinix-i Rite Edition, a new member of the Infinix-i family.

As its new flagship, the Infinix-i Rite Edition incorporates state-of-the-art technologies allowing whole body coverage, from head to toe without any patient or table movement and free head access, which is a strong demand from interventional radiologists and anesthetists during complex procedures, is realized through 270° isocentric C-arm rotation. The unique lateral C-Arm stroke expands and simplifies your access for radial approach, shunt angiography and port implants.

“Our approach is simple: it’s the equipment that moves around the patient and not the other way around. This translates into optimized visualization and positioning in the examination room”, says René Degros, Business Unit Manager for X-Ray with Toshiba about this new “3D anywhere” system as it is already being called among physicians.
The system provides full automatic synchronization between the flat panel detector & collimator for correct head up display regardless of C-Arm position, developed for the most challenging clinical procedures.

As procedures are getting more complex, advanced 3D acquisition becomes a strong requirement. With the introduction of the Infinix-i Rite Edition, you will discover new horizons in 3D imaging.

The outstanding 3D rotation coverage of 210 degrees with C-arm at table left/right side in combination with an amazing speed of 80 degrees per second is the key enabler for the unmatched image quality delivered by the Infinix-i Rite Edition. Especially its unparalleled rotational speed will result in a significant reduction of breathing artefacts and contrast media.

Benefit from Toshiba’s Dose Rite Philosophy which brings together what belongs together: dose saving technologies & dose awareness tools. Drastically reduce radiation dose to your patients and yourself by applying state of the art dose saving techniques available such as Live Zoom, Spot Fluoroscopy, Spot ROI and our real time Dose Tracking System.

More information: http://tinyurl.com/zd3w3dh
“Our business foundation is based on partnership.”

Ever since our foundation over 100 years ago, we have opened new eras in various fields with our epoch-making innovations and we are proud of many “world firsts”. It takes strong collaboration and a dedicated team to achieve such efforts in developing ongoing innovations.

While reflecting on our history and achievements, we are now ready to move on to yet another new era in a collaborative manner with the continued support of our customers.

A final agreement concerning the sale of Toshiba Medical Systems Corporation to Canon Inc. was reached in March. As a result, Toshiba Medical is now independent from the Toshiba Group, but will continue to operate as usual.

From the beginning, my aim during this acquisition phase was to achieve smooth transition while maintaining our core values, and network with customers that we have built through our 100 year history.

Our business foundation is based on partnership with customers and this will not change.

We will continue to invest in R&D, our core competencies and our growth strategies.

While diagnostic imaging will always be our core business, we understand the importance of enhancing our solution business in the short-term, and we are seeking to expand our business domain into the bio-technology field in the mid to long-term.

Our “Made For life” philosophy is a driving force behind who we are and what we do and we are excited that our new partner Canon will not only bring forth new opportunities for our business but will help maintain and enhance our Made For life philosophy.

Our goal is to continue to contribute to improved healthcare opportunities for patients, and enhanced healthcare delivery by industry professionals through uncompromised performance, comfort and safety considerations of the solutions Toshiba Medical provides. The strong and long lasting relationships built with our customers and partners along the way, ensures Toshiba Medical’s future growth and ongoing contributions to society for the next 100 years.

Made For life

Toshio Takiguchi
President and Chief Executive Officer
Toshiba Medical Systems Corporation
At Toshiba Medical, everything we do is made for life.

For over 100 years, the Toshiba Medical ‘made for life’ philosophy prevails as our ongoing commitment to humanity. Generations of inherited passion creates a legacy of medical innovation and service that continues to evolve as we do. By engaging the brilliant minds of many, we continue to set the benchmark because we believe quality of life should be a given, not the exception.

HERITAGE
For over 100 years, we have proudly pioneered the development of imaging solutions for the global medical community. Our rich history of collaboration has engaged the brilliant minds of many who will continue to set the benchmark for another 100 years and beyond.

PARTNERSHIPS
At Toshiba Medical, we build relationships based on transparency, trust and respect. Our commitment to progressive medical, corporate, academic and community partnerships lies at the very heart of what we do and why we do it. Together as one, we strive to create industry-leading solutions that deliver an enriched quality of life.

PASSION
A unified passion to the ‘made for life’ philosophy is ingrained in our DNA. Our dedicated team and partners collectively push the boundaries in everything we do because we believe quality of life should be a given, not the exception. Generations of inherited passion builds a culture that is driven to excel for the benefit of humanity.

QUALITY
A shared dedication in providing quality products and support enables us to deliver a seamless service of patient care, now and for future generations. At Toshiba Medical our quality processes underpin everything we do, reinforcing a future that is made for life.

SERVICE
Built on a tradition of ‘people first’, our globally recognised commitment to prompt and personalised service, after sales support and quality education collaboratively lies at the heart of our ongoing success. We take care of our partners so they can take the best care of their patients.

INNOVATION
Thousands of minds and millions of hours over a century of time have built a legacy of innovation that continues to evolve as we do. From our collaboratively rich research and development past we advance towards a bright future of technological innovation that is made for life.

HEALTH
It is our mission to provide medical professionals with solutions that support their efforts in contributing to the health and wellbeing of patients worldwide. Our goal is to further develop and grow Toshiba Medical’s role in delivering optimum health opportunities for patients and health professionals through uncompromised performance, comfort and safety features.

Toshiba Medical’s focus on health proudly defines who we are and what we achieve through our made for life philosophy.

Made For life
Ultra-helical to image the heart and entire aorta and iliac arteries in just one breathhold and one contrast injection. “This particular machine is ideally suited for heart and vascular examinations,” said Dr. Subhash Srivastava, a Radiologist specializing in cardiovascular diagnostics. “I believe that the future will bring increasingly advanced examinations of this type. Naturally, it is important to be at the forefront in terms of technology, methodology and advanced equipment, but it is equally essential to establish good cooperation in various ways: between doctors and nurses, radiologists and cardiologists and between health care professionals and suppliers. It is only when all this teamwork functions properly that healthcare can carry out its primary task.”

Preoperative TAVI planning was an obvious option right from the beginning, when the new Toshiba Aquilion ONE™ CT scanner, was installed at Karolinska University Hospital, in Solna, Stockholm, Sweden. After a few years, this investment in the latest CT technology for vascular examinations is bringing good results. Referring physicians have discovered new opportunities, and TAVI-examinations are in full swing.

Despite its relative novelty, TAVI (Transcatheter Aortic Valve Implantation) is a practice that has become very popular. The treatment means that even patients, who are not able to undergo surgery, can receive a new aortic valve, and the procedure is currently available at all hospitals in Sweden that offer thoracic surgery.

A special CT protocol has already been developed for TAVI examinations at Karolinska University Hospital’s facility in Huddinge, Stockholm. Now, Karolinska’s Solna facility, also in Stockholm, is taking a further leap forward in the field, with its state-of-the-art Aquilion ONE CT scanner. The protocol takes advantage of the benefits of volumetric one rotation imaging of the heart combined with the speed of ultra-helical to image the heart and entire aorta and iliac arteries in just one breathhold and one contrast injection.

“This particular machine is ideally suited for heart and vascular examinations,” said Dr. Subhash Srivastava, a Radiologist specializing in cardiovascular diagnostics. “I believe that the future will bring increasingly advanced examinations of this type. Naturally, it is important to be at the forefront in terms of technology, methodology and advanced equipment, but it is equally essential to establish good cooperation in various ways: between doctors and nurses, radiologists and cardiologists and between health care professionals and suppliers. It is only when all this teamwork functions properly that healthcare can carry out its primary task.”

Karolinska University Hospital invests in TAVI examination

1 Radiologist specializing in cardiovascular diagnostics at the Karolinska University Hospital, in Stockholm, Sweden.
“We all need to think about how we can work together to provide the best help to those who need us,” he added. “Our focus should always be on the patient first and foremost.”

Most of those who undergo TAVI are older patients - people, for whom surgery is considered too dangerous. Preoperative CT examinations should, therefore, have particular focus on reducing IV contrast as much as possible, since these patients generally have impaired renal function.

Radiography Nurse, Anna Eldrot Eliasson, is Karolinska Solna’s contact person for cardiovascular examinations performed with Aquilion ONE, including the TAVI application.

“We have many patients who were born in the 1930s, and even the 1920s, so, of course, high creatine levels can sometimes be a challenge,” she explained. “In these cases, we can often manage by injecting a little less contrast, since the image quality is still so good with this machine. The normal standard dose is 70ml for patients over 70 years. Of course, everything is performed in consultation with our resident- and referring doctors here, and it is rare that anyone has doubts.”

This is important from a risk-benefit perspective. When asked about any other special challenges specifically related to CT examinations for TAVI planning, Anna responded that the most important aspect is about dealing with the patient.
"The advanced part of the procedure is handled by the system itself, through carefully developed protocols, specific reconstruction and customized software for sophisticated visualization."

She emphasized that it is important to make patients feel safe, ensure that they are calm and relaxed and breathe properly, also to obtain a good ECG signal.

Managing the actual technology in connection with the scanning is regarded as relatively simple. The advanced part of the procedure is handled by the system itself, through carefully developed protocols, specific reconstruction and customized software for sophisticated visualization.

"Now that the protocols have been fine-tuned, I feel that everyone now thinks that the machine is very straightforward to work with," said Dr. Srivastava. "However, it has taken some time to get everything in place. Obviously, a successful examination with a brand new, modern CT scanner requires both advanced training and configuration."

Dr. Srivastava and Anna are very satisfied with the support they have received from Toshiba during the process. Over the past six months they have seen clear results from their efforts.

"We are now receiving a growing number of referrals," remarked Anna. "We are seeing an increase in the number of TAVI cases as well as patients with acute cardiovascular problems."

"Everything related to the heart and blood vessels feels more exciting and fun to work on, now that we have the Aquilion ONE, because it is so good," she said. "This applies not only to TAVI. Just today, we performed a leg vessel examination. The doctors are extremely pleased with the quality of the examinations."

Anna also appreciates the speed of the system and the fact that the CT scanner covers the entire heart in one rotation, a great advantage in many examinations.

With his vast experience and interest in cardiovascular diagnostics, Dr. Srivastava is delighted to have established a range of collaborations, which are effective in several aspects.

"We must constantly maintain a high level of expertise in the field, for both nurses and doctors," he said. "This requires constant development of both personnel and practices, in collaboration with, and support from Toshiba. Lately, there has been rapid progress in the field of TAVI, and there are many more exciting aspects of cardiovascular diagnostics to focus on."

**FACTS**

Symptomatic aortic stenosis has a high annual mortality of about 50%. Implantation of a prosthetic valve is the only way to reduce mortality. Valve implantation can be through surgical or catheter introduced techniques (Transcatheter Aortic Valve Implantation, TAVI). The prostheses used for TAVI consist of an artificial valve of animal material, which sits in a metal mesh.

Advanced age, general frailty, impaired renal function, impaired lung function, and previous cardiac surgery are examples of risk factors that may mean that TAVI is preferable to surgery. TAVI can be performed with good results for patients aged over 90, if the patient is otherwise deemed eligible. In its new national guidelines for cardiac care, the Swedish National Board of Health and Welfare has proposed the wider use of TAVI. Now, the treatment may be considered routine, even for patients, who can undergo valve replacement by conventional surgical means, but where the risks associated with surgery are deemed to be high.

The majority of TAVI procedures are performed via the femoral artery approach, and usually with local anaesthesia. The procedure takes about two hours and the treatment time is about five days. TAVI planning CT scans can measure the size of the aortic valve in detail and assess whether the arteries are of sufficient size to be able to insert the artificial valve. In case the femoral artery is too narrow, TAVI can be performed via the subclavian artery, by direct puncture of the aorta or by transapical procedure. In these cases, the patient is anaesthetized.
Managed Equipment Services
Introducing an innovative and flexible “state-of-need” business model

Lo Wuite 1), Dick Blesing 2)

In many aspects, 2016 truly marks the dawn of a new era for Toshiba Medical Systems. Lo Wuite, General Manager Managed Equipment Services (MES) Europe, and Dick Blesing, General Manager Netherlands, explain how Toshiba Medical System is becoming a true healthcare service provider, thanks to an innovative and flexible “state-of-need” business model.

Toshiba has now added “provider of services” to its historical role of “technology supplier”. What are the rationales behind this structural business model transformation?

Lo Wuite: From a macroscopic point of view, European healthcare markets are for the most part affected by important cost-saving measures, while facing the complex challenges of an aging population and increase of chronical diseases. These markets are at a turning point of their history and thus have to innovate and renew the way they provide care to their citizens. Given this context, the old model where a company like Toshiba would basically sell medical equipment financed by hospitals or any another public or private stakeholders appeared to us as becoming outdated and unsustainable.

As a matter of fact, we are moving our main focus from a purely product approach to combined approach of products and Managed Equipment Services (MES) offering, where we partner with our customers by providing a very broad range of solutions that specifically aim to tackle main hospitals’ hurdles. MES can thus include purchasing and financing (directly or via a third-party partner), technology supplying, performance management and optimization, and education.

In our new business model, hospitals primarily deal with our MES division, which means that they don’t primarily buy products anymore. In our new approach, hospitals now partner with Toshiba, which supports them with a comprehensive service offering through an outsourcing agreement, which stipulates the level of collaboration and service level agreements that ties Toshiba and its partner. Together with the hospital, we jointly discuss the requirements of the hospitals, in terms of the technology, services and replacement timelines they foresee for the future.

Do you perceive some reluctance from your healthcare partners in truly partnering with private companies to improve their processes?

Lo Wuite: This shift of Toshiba from a product-centered approach to a service focus is evolving in almost all pharma markets globally, and the cost-containment context currently hitting most of the other European healthcare systems has been a powerful catalyst to implementing these new kinds of partnerships. The Netherlands situation stands as a very edifying illustration of how quickly these partnerships can be developed: before 2008, only hospitals facing major financial problems were interested in partnering with the industry, whereas an increasing number of hospitals have shown interest over the past few years. Due to changes in the way the government subsidies hospitals, the hospitals are forced to steadily rethink the way they can continue to provide high quality healthcare and how to finance it.

Nevertheless, there are still a large number of hospitals that consider their processes are being optimal, meaning that the use of external benchmarks and implementation of best practices remain rather poorly executed.

Dick Blesing: We still notice that hospitals that are not facing financial problems are probably more reluctant to reevaluate their processes. It is thus our role to ensure they understand the value we can offer them. Nevertheless, Dutch hospital board members stay in the board for a relatively short period before moving to another challenge. Long-term benefits are thus probably less valorized than short or mid-term perspective approaches.

This also explains why we strive to engage as much as possible the management level, who are usually staying longer in the same institution than hospital board members and can enjoy the benefits of long-term partnerships.
Nevertheless, the general trend in the Netherlands is that hospitals will have to deal with more complex patients in the upcoming years (due to aging population) with less money, so hospital mindsets are also steadily more open to partnering with private companies and jointly finding solutions.

Some other MedTech competitors like Siemens or Philips are also currently deepening their commitment within the healthcare system far beyond the basic delivery and maintenance of technology products. What differentiates Toshiba MES’s offering from that of your competitors?

Lo Wuite: Contrarily to our competitors, Toshiba’s service offering is not primarily focused on our in-house technology, and strives to propose a broader freedom of choice to our partners. As service provider, our essential target is to provide the most adapted solution to our clients. In this vein, we can also provide, finance, and manage competitors’ equipment- if they are the most adapted to our partners’ needs! We obviously prefer providing our partners with Toshiba’s equipment, but sometimes our solutions are not the best fit for our customers’ requirements. Operating now truly as a service provider, our main objective is that our solutions perfectly meet the needs of the hospitals, whatever the brand of the products we ultimately supply would be.

Dick Blesing: In this vein we, at the Dutch office, truly operates as a supplier of the MES division. When the MES agree on a partnership with a healthcare institution, they will then benchmark which brand, which product, and which technology will offer the best fit with this medical institution’s needs. Depending on the products that the Dutch affiliate can offer to the MES division, this latter will thus decide to choose our products… or not! Operating as a supplier also means that the local affiliate is obviously not aware of the details of the partnership that ties the MES division and the hospitals, and we then truly apply to the different tender calls coordinated by the MES division like any other supplier will do it.

At first sight, this business model could potentially render us more vulnerable, but in reality it really strengthens our organization. Firstly, we believe that if we are able to provide an excellent service offering to our partners, we will also ultimately receive more demand for our equipment.
Secondly, creating this technology competition between our products and our competitors’ is the best driver to move us forward: we know that even if Toshiba has a partnership with a hospital, we will nevertheless have to offer the best products solution to ensure our products are eventually chosen by the MES division.

How do hospitals and other business partners react when you announce that you are ready to finance competitors’ products if they are the most adapted for your patients’ needs?

Lo Wuite: Hospital boards are sometimes doubtful – particularly at the beginning. We are however able to showcase many corporate case studies and real situations that demonstrate this openness to truly act as a service provider as well as our effort to not exclusively give advantage to our products. For instance, in a mid-size hospital in the UK, we financed, supplied and now manage the entire equipment solutions of this hospital, which represents more than 8,000 pieces of equipment. In this hospital, only a minor share of the overall volume equipment distributed are actually Toshiba products.

Dick Blesing: In a 10 or 15-year period, if we honestly analyze the situation, it is really seldom that one single company alone is able to offer the best or most suitable solution to its partners for a given technology. Our competitors use a less flexible business model, where clinical freedom of choice is much more limited.

Lo Wuite: While our competitors’ service offering remains mainly based on their products, our service offering is primarily and strictly oriented toward the final quality of service we want to deliver, even it implies distributing our competitors’ products. We focus on the best solution for our customers rather than the “brand” of the product.

Besides the possibility to distribute your competitors’ products if they offer the best fit with your partners’ needs, what other key features of the MES demonstrate its flexibility?

Lo Wuite: Technology is evolving very quickly and products’ innovation cycles are shorter than the current replacement cycles – usually between 10 and 15 years – that most of the hospitals are financially able to sustain. As a result, hospitals currently tend to ask for state-of-the-art
products at each replacement, as they know the next ones will only be acquired at least a decade later. As premium equipment also obviously comes at the highest price, hospitals over-invest at the beginning of their equipment contracts despite already knowing this technology will probably become technologically obsolete well within the financial life cycle of the product.

To tackle this non-sense, we implemented a “state-of-need” approach in our MES partnership. “State-of-need” can obviously sometimes be synonym of “state-of-the-art” equipment, for spear point clinical and development areas of the hospital for instance. Most of the hospitals however don’t need such ultra-sophisticated equipment for all their daily treatments.

With our “state-of-need” approach, the MES offering provides hospitals with the technological level they truly need for their patients, either with brand new or even sometimes refurbished equipment. We indeed have partnerships with University Medical centers, where state-of-the art products are always replaced every two or three years. Once it is removed from these hospitals, this kind of equipment can perfectly suit smaller or peripheral medical centers, which do not treat the most complex patients. These centers can thus access high-quality products, which are only two or three years old, for a very competitive price.

Beside financial and technological aspects, how are clinical and patient outcomes improved by your offering?

Dick Blesing: Firstly, the MES makes hospital staff’s life easier, as the MES manager operates towards the hospital as a ‘one-stop shop’ supply manager, while an average European hospitals can deal with over a 100 different suppliers only for imaging departments!

Lo Wuite: Physicians and hospital managers should be able to uniquely focus on treating their patients and improving the clinical outcomes of hospitalization. Thanks to our approach, the medical teams give us their requirements, and we will prepare a benchmark of the best available options to fulfill their needs. As this kind of partnership is gaining in importance, we notice that physicians increasingly rely and trust our propositions, while they particularly enjoy not wasting time anymore in product negotiations with different suppliers. Thanks to our partnerships, physicians and medical staff simply provide care, and this is exactly how the situation should be.

The MES business model is progressively being implemented in all European markets. Do you think that it is set to become the partnership of reference in the Netherlands in the upcoming years?

Dick Blesing: Without any hesitation: yes! This approach, which is not centered nor conceived to exclusively sell our products, is the service offering that displays the better outcomes for healthcare partners, by providing them with the solutions that will truly and perfectly meet their needs.

Nevertheless, I call for a closer collaboration with hospitals: we still do not perceive each other enough as true partners; despite this being the only way to strengthen an affordable and innovative Dutch healthcare system. Companies and hospitals have their own knowledge and expertise, but if we don’t manage to combine these two expertises, we will never be able to effectively improve the Dutch eco-system, which should be our shared responsibility and duty. If the MES offering indeed represents a new business model for Toshiba, it is above all a true partnership that we want to propose to our Dutch healthcare partners.

More about MES

In a world of growing demands and limited budgets, managing the costs of healthcare is very challenging. A Toshiba Managed Equipment Service (MES) partnership is a valuable option for your facility to reduce the financial and operational risks of your medical equipment planning while delivering better patient care.

Covering everything from procurement and financing to maintenance, asset management, commissioning and decommissioning of equipment, staff training and a dedicated helpdesk, a Toshiba MES partnership is a comprehensive solution for all your medical equipment needs. Together we will continuously strive to improve your workflows and processes so you can serve your patients better and more efficiently.

With more than ten years of experience in successfully managing MES partnerships in Europe and around the world we provide the expertise and trust you require. As a supplier with an ISO-certified quality system for MES partnerships we ensure fully transparent management and customer satisfaction.
THINK SERVICES FOR ALL YOUR MEDICAL EQUIPMENT NEEDS
Partnering with a leading healthcare provider such as Toshiba under the umbrella of a Managed Equipment Service partnership enables you to focus on delivering the best patient care while we manage your equipment with the highest standards of quality and efficiency at fully projectable cost. Imagine the convenience of one reliable partner covering all your medical equipment needs.

Managing your technology
From pro-active maintenance to servicing, from procurement to decommissioning and replacement – as a full-service provider we will manage all aspects of your medical equipment under the MES agreement. A central helpdesk dedicated to your facility will provide continuous support and handle all service calls quickly and efficiently.

Maintenance and service from a single source
Maintaining a large equipment park can be challenging. In an MES partnership we take on this responsibility. We guarantee uptime and service schedules under strict Service Level Agreements and, in accordance with our "Made for Life" promise, we make sure your equipment is replaced timely to best meet your clinical needs at all times.

Clinical freedom of choice
A Toshiba MES is vendor-independent. Although we offer a wide range of premium performance imaging equipment, we provide our clients the freedom of choice to ensure you will be working with the equipment that suits your clinical needs best. In case these needs change, you can amend your equipment plan at pre-agreed service fee adjustments.

MINIMIZE YOUR BUDGETARY RISKS WHILE IMPROVING YOUR PERFORMANCE
A Toshiba MES partnership helps you to take the key risks and spikes out of your medical equipment capital spending. While we assume those risks and manage your assets, you can plan your operations with fully projectable and pre-determined monthly payments covering everything from equipment service and maintenance to new purchases and financing, as well as staff training.

Capital asset planning
Each MES starts with developing a long-term investment plan – typically 10 to 15 years – based on your operational objectives, clinical needs and medical equipment requirements. This ensures clearly defined targets and fully transparent processes from day one of our partnership. Should your requirements change over time we will jointly adapt your technology plan to meet your needs.

Fixed monthly charges
An MES partnership will convert your variable investments in capital assets and new technology into a fully projectable service charge with a pre-determined monthly fee. Under the agreement we will provide regular reports on equipment uptime, service and maintenance status and user support with clear, quantifiable scores to match or even exceed the agreed Service Level Agreements.

You remain always in control
With our cloud-based AMP2HI software you have at all times full access to all relevant information with regard to your installed equipment, service schedules as well as contractual spendings. Should your clinical need change over time, the AMP2HI software allows you to simulate the impact of changes in equipment or services on your monthly charge.

SHARING BEST PRACTICE SOLUTIONS MEANS IMPROVING YOUR BUSINESS
With many years of experience in the widest variety of hospital environments our teams of clinical, technical and finance professionals provide expert advice helping you to optimize diagnostic procedures, capital asset utilization and financing strategies. Our six sigma-trained specialists can assist in optimizing hospital processes and patient pathways – all with the aim to improve efficiency while delivering best clinical services.

Operational performance enhancement
As a major supplier to the medical imaging market we provide a solid financial, clinical and technical foundation to successfully manage your equipment needs. Getting all services from one source means you can benefit from Toshiba’s significant procurement power and reduce the complexity of your maintenance and service needs.

Capital asset utilization
Requirements can change. Therefore, a long-term agreement needs flexibility. By regularly reviewing and adjusting the investment plan against your actual and projected needs we ensure effective utilization of assets, for instance by re-scheduling equipment moves or replacements. To bridge new installs or temporary high workloads we can provide short-term rentals and mobile solutions.

Clinical workflow optimization
Sharing best practice experience is an important part of our customer relationship. As a leading manufacturer of medical imaging equipment our clinical experts can draw on extensive know-how in the widest range of clinical specialties. We work with leading institutions around the globe on continuously improving diagnostic outcomes and advancing clinical pathways.
The era of i-series has begun.

The Future of Ultrasound - Shaped by Fifty Years of Heritage

Innovation is deeply embedded in our history, as well as in our future. Half a century ago, Toshiba made its first steps into the world of Ultrasound, determined to improve the quality of life for all people around the globe.

Now, 50 years later we take another leap forward with the introduction of the Aplio i-series, a premium diagnostic ultrasound system that combines superior image quality with the most advanced clinical applications in a highly intuitive design.

Aplio i-series is the result of 50 years commitment to Ultrasound, in which we have always stayed true to our ‘Made for Life’ philosophy. With the Aplio i-series, we are writing a new chapter in Ultrasound history and provide you with technology that is ready for the biggest clinical challenges of today – and the future.
Aplio i-series is here!
Fifty years of dedication to Ultrasound, and carefully listening to our customers from around the globe, have led to Toshiba’s newest premium Ultrasound solution: The Aplio i-series.

This system combines industry-leading image quality with the most advanced clinical applications in a highly intuitive design. The Aplio i-series is engineered to boost clinical confidence during quick routine examinations, as well as the most challenging cases. The Aplio i-series supports an abundance of expert tools that help change patient pathways and increase departmental productivity, without compromising on clinical precision.

**INNOVATIVE TRANSDUCER TECHNOLOGY**
All transducers are designed to do more with less, from ultra-wideband transducers that combine two probes in one, to 24 MHz probes that are capable of revealing extreme fine detail.

**PREMIUM CLASS ERGONOMICS**
A premium Ultrasound system in a remarkably compact and light-weight design to optimize flexibility and ergonomic relief in every clinical situation.

**INTUITIVE OPERATION**
Onscreen navigation and a fully customizable touch command screen visually guide you through your examinations, making them easier and quicker.

**INTELLIGENT IMAGE OPTIMIZATION**
Simplified control panel together with a range of automated image optimization tools help you to increase efficiency, with less focus on the system and more on your patient.

**POWERFUL PROCESSORS**
Extraordinary computing power enables complex 4D visualizations, advanced flow imaging and real time quad-modes that help you to get the most reliable results in the shortest time.

**IBEAM ARCHITECTURE**
From the smallest to the toughest patients, iBeam-forming technology enhances clinical accuracy by delivering images with unprecedented clarity and penetration.
Hyaluronic acid protection of cartilage

Xavier Alomar MD

A 42-year old marathon man, healthy and asymptomatic, runs a marathon every 15-30 days. The patient underwent a MRI exam of both knees one month before a marathon and another after the injection of hyaluronic acid (4ml high density) in the articular left knee and performed a marathon of 45 km. This preliminary study intends to assess the protective effect of the hyaluronic acid injection in the patellar cartilage during a long and loading effort. The MRI protocol includes axial spin-echo T2 mapping sequence (TE=24.8, 37, 49, 62, 74.4, 90 ms, Slice thickness=3mm, TR= 2000 ms, FOV=14x14, Matrix=320x192).

POST-PROCESSING AND ANALYSIS

MRI manufacturer post-processing was first performed study by study, but it was difficult to assess the value variations in the cartilage, due to signal intensity changes in this area. Post-processing was then performed on a dedicated workstation (OleaSphere®) which allows to assess quantitative measurements of T2 map computed using a Bayesian approach and to visualize the T2 maps from two different dates (before and after running). T2 mapping is intended to measure the transverse relaxation.

Figure 1: left knee. The middle image shows T2 map before running. The right image shows T2 map after hyaluronic acid injection and 45 kilometres of running. The left map shows the subtraction of these two dates.

Figure 2: right knee. The middle image shows T2 map before running. The right image shows T2 map after 45 kilometres running. The left map shows the subtraction of these two dates.
from a spin-echo sequence, and T2 parameter being very sensitive to noise and sampling, the Bayesian probability theory is used to estimate this parameter.

Automatic co-registration of both exams was applied based on the femur localization. Since the patella moved between the two exams, a manual adjustment was done to match the cartilage zone.

Subtraction maps were computed to assess value changes for both knees. Quantitative values allow to confirm and quantify post-effort lesion.

**IMAGE FINDINGS**

A dissection of medial patellar cartilage of the left knee is observable, water was trapped in the crack and the T2 maps values increase. The subtraction map shows no significant changes on T2 values in the lateral patellar cartilage and minimal changes in the crack. The right knee did not undergo injection, the subtraction map clearly shows higher T2 values than those of the left knee that suggests an increase water proportion in the matrix.

The comparison of both subtraction maps from T2 maps before and after running confirms the separate analysis done previously. Focal regions of interest (ROIs) containing thirty five pixels (7mm²) were drawn in the central patellar cartilage of the left (ROI1) and right (ROI2) knees and a significant difference was remarkable (ROI1=2.23; ROI2=7.38) (Figure 3).

In addition, free hand ROIs surrounding the cartilage were drawn in the left (ROI3) and right (ROI4) knees and they also show a major increase in values of the subtraction map of the right knee, compared to those of the left knee (ROI3 =1.95; ROI4=5.57) (Figure 4).

**DISCUSSION**

The cartilage in joint areas helps to absorb the strengths and share the loads supported by the joints. These structures supporting repeated loads for many years can be broken, but their degeneration always comes before. The consistency of these structures changes but without any modification of their morphology or their size.

T2 mapping sequences are commonly used to quantify the grade of the edema and the alteration of connective tissues, part of the cartilages in the human body. Therefore, the degree of chondral degeneration can be measured before its breakage.

In order to assess the efficiency of a treatment intended to repair or protect the articular cartilage, it is essential to undertake a longitudinal study, using images that quantify the chondral damage prior and post-treatment. Measuring the signal variations in the cartilage using ROIs is very complicated. That is why subtracting images from two different exams is very useful to assess the changes in the cartilage composition. Such technique helps to rapidly, simply and objectively quantify the effects of the different chondral therapies. Figures and statistical works allow to demonstrate their efficiency.
Unleash the power of imaging by ensuring the right person has the right images at the right time. Vital’s enterprise imaging solutions facilitate streamlined access to images at relevant and meaningful points of care, driving better patient outcomes and improved imaging operations.
Superb Micro-Vascular Imaging – A new tool for the sports physician

Dr Steve McNally 1)

In the past decade there has been an explosion in the use of diagnostic ultrasound by sports medicine practitioners, predominantly physicians/surgeons but also the allied professions such as physiotherapists. The ultrasound scanner has become a useful (and sometimes invaluable) aid to the team physician when providing daily care to his/her athletes at the clinic, sporting venues and when travelling.

Grey-scale ultrasound provides anatomical and structural information that can also be assessed under dynamic functional stress and gives immediate information that can influence diagnostic decisions, shape training and rehabilitation programmes and provide visual feedback and education to the athlete patient. Additional functionality such as colour and power Doppler enables the visualisation of vascularity and objective measurement thereof within and around the joints and soft tissues that form the vast majority of presentations to a sports/musculoskeletal physician. Superb Micro-Vascular Imaging (SMI) is the latest addition to the armoury available to the sports physician/radiologist with access to Toshiba’s diagnostic ultrasound hardware.

CLINICAL RELEVANCE
Why is visualisation of vascularity important when dealing with sports medicine cases? There has been a shift of thought regarding the presence of vascularity in or around soft tissues, joints or bony enthesis in recent years; maybe the excitement of being able to detect neovessels following the addition of colour and power Doppler.

1) Head of Football Medicine & Science, Manchester United, United Kingdom.

Figure 1: cSMI of Achilles tendon showing subtle neovascularisation in subacute tendinosis

Figure 2: Grey-scale and mSMI comparison of subtle Achilles tendinosis
functionality on the early portable ultrasound scanners around 15 years ago led the sports medicine practitioner to an impression that this was a ‘bad’ pathological entity. Moreover there was a tendency to associate such vascularity with painful conditions or injuries and an assumption that the associated neural proliferation was the cause of pain and therefore a temptation to obliterate the neovessels by various treatments. This was particularly true in cases of tendinopathy; however further research uncovered multiple potential pain generators including chemical mediation and psychological factors that play a significant part in the appreciation of tendon pain irrespective of the degree of neovascularity. Vascularity in tendons increases after exercise so the timing of the scan is important and as the neovessels are easily compressed, transducer pressure and positioning of the joint the tendon crosses can heavily influence the appearances. The author’s view from experience of scanning many athletes is that neovascularity in an injured soft tissue is a good thing as it suggests that a repair/regeneration process is in progress; there is much more concern about a non-painful weight-bearing tendon where an inert hypoechoic lesion is detected on routine screening as this implies a lack of healing response and potential loss of tensile load-bearing capacity which translates to a higher risk of rupture. In joints however neovascularity tends to be associated with an unwanted chronic inflammatory process (synovitis) which may be a result of systemic disease, post-surgical or reactive to joint instability or impingement.

Figure 3: cSMI of periosteal neovascularity in tibial sesamoiditis

Figure 4: cSMI of peritendinous/periosteal neovascularity in healing navicular tuberosity fracture

Figure 5: mSMI Hold image of patellar tendon with advanced proliferative proximal tendinosis

Figure 6: cSMI of healing proximal myotendinous tear in adductor longus muscle
Detection of neovascularity by ultrasound modalities must therefore be interpreted in context of the following:

**Diagnosis**
Ultrasound scanning is usually a confirmatory adjunct when diagnosing an athletic injury suspected from clinical history, clinical examination and sport performance findings. However sometimes the presence of subtle neovascularity can clinch a diagnosis that is not completely evident from the history or examination alone; this is often in the subacute phase where a healing response is already in progress as the athlete has continued training or competing with a niggling injury leading to subjective or objective reduction in performance. Examples that spring to mind include a small intramuscular tear that might prevent an athlete from sprinting at absolute top speed but causes no impairment in all other respects or a very subtle Achilles tendinosis that only causes pain on a change of surface/pitch firmness.

**Staging**
Tendinosis has well recognised stages of progression and the presence or otherwise of neovascularity is a defining factor confirming that it has progressed from the acute reactive phase into the proliferative phase; this has important implications for clinical management in terms of exercise load management and the use of anti-inflammatory medication (the latter may be useful in the early reactive phase but detrimental to collagen formation in the proliferative phase).

Neovascularity following structural muscle injury indicates an attempt to regenerate muscle tissue which is a preferable outcome for an athlete when compared to seroma formation or fibrosis; many treatments used by sports physicians treating muscle injuries specifically aim to stimulate production of Vascular Endothelial Growth Factor (VEGF) whilst also inhibiting Transforming Growth Factor (TGF) in order to promote regeneration over repair. This can sometimes accelerate recovery and return to athletic activities but more importantly restores better functionality and reduces risk of re-injury.

**Healing response**
The majority of athletic muscle injuries are functional in nature i.e. with no evidence of macroscopic structural disruption on ultrasound or MRI even if oedema may be present from lymphatic or perimuscular ‘congestion’. In cases where there is fibre or bundle disruption to an extent that can be detected within the resolution capacity of imaging modalities the presence of neovascularity indicates a favourable healing response. If left to natural means vascularity encircling a muscle tear is usually visible at around 14 days post-trauma.

**Effectiveness of treatment/early rehabilitation**
Medical treatments that aim to promote neovascularity in muscle injury such as High Power Laser Therapy, Autologous Plasma injection, Platelet-Rich Plasma injection or Actovegin can accelerate the production of neovessel formation so monitoring via ultrasound is a useful way of assessing the patient's response to such treatments; neovascularity can be observed around the 7 – 10 day stage if these treatments are effective.

**Determination of readiness to load tissues**
Similarly, regression of the neovascularity and replacement by new muscle, tendon or ligament fibres indicates the onset of the remodelling phase and readiness to load the injured tissue in a more functional and challenging manner specific to the demands of the sport.

**Ongoing monitoring**
Tendinopathy is often a chronic relapsing and remitting process in athletes in line with the mantra 'once a tendinopathy always a tendinopathy', however it can be managed and does not necessarily lead to an inability to compete at the athlete's maximal performance level. This of course requires judicious training regimes and optimal preparation and recovery strategies but monitoring of the tendon structure and vascularity can play an important part in raising confidence in the decision making by the athlete and his/her coaches, trainers and therapists. This is perhaps the greatest benefit of ultrasound scanning in general as a modality in the hands of a sports physician as it becomes an extension of the normal clinical and functional assessment process and being very visual, facilitates education and awareness of the athlete and his/her support team with regard to the structure and physiology of musculoskeletal tissues.

**Comparison of Doppler and Superb Micro-Vascular Imaging (SMI)**
Power Doppler has generally been preferred to colour Doppler as the sports physician is less interested in direction of vascular flow and more interested in the detection of small low flow neovessels and the pattern thereof in injured tissues. Power Doppler leads to unwanted 'noise' in the image and a very steady hand is needed when scanning to avoid artefact when looking for subtle neovascularity e.g. when assessing healing in a minor muscular tear.

Superb Micro-Vascular Imaging provides a much clearer and defined outline of the vascular pattern with less movement-related artefact and the facility to employ the ‘Hold’ function allows the vascular tree to be constructed over several seconds whilst the operator holds the transducer in a static position. The added
attraction of both monochrome (mSMI) and colour (cSMI) options makes this a more powerful visual tool when discussing findings with the athlete. Building a library of sequential scans is a useful record of progress particularly when managing a chronic injury such as tendinosis.

**FUTURE DEVELOPMENTS**

With the advent of sports science the modern athlete and coach rely heavily on objective data and statistics in order to complement their subjective opinions and assessments; the addition of quantification of microvascular blood flow could be a useful development for the sports physician to further enhance the advantages that Superb Micro-Vascular Imaging has over power and colour Doppler. Athletes respond to numbers and the addition of a quantifiable assessment of blood flow in healing tissues would add another level to the decision-making during rehabilitation or when managing a chronic injury through a training programme. In the meantime correlation of the image appearances available via SMI against objective training loads and injury presentations will provide a more evidence-based approach to injury management.
Exercise Myocardial Performance in Adolescent Athletes

A Novel Approach Using 2D WMT and Simultaneous Oxygen Consumption Analysis

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The assessment of cardiac function is essential in the athletic population not only as part of the screening process for underlying cardiac disease, but also to longitudinally assess performance and training adaptations.

Currently, echocardiography is however performed only at rest and exercise performance, if assessed, uses traditional cardio-pulmonary exercise testing (CPET). A limitation of CPET is its inability to provide data on myocardial functional responses to exercise, the dominant process to increase cardiac output to enhance oxygen delivery 1 and it is therefore only an indirect description of myocardial reserve. Data is particularly sparse in children’s and adolescent’s athlete population groups. But as sports professionalism and training levels in elite youth athletes is reaching that of their adult peers, the search for non-invasive, discriminative and predictive imaging tools to assess the health of the young athlete, for this rapidly increasing youth population, has gained importance. Equally, the question about how to assess exercise limitations is applicable and as important in many paediatric disease groups e.g., congenital heart disease (CHD) and novel methodologies and protocols to assess cardiac function during exercise are needed.

In search for echocardiographic assessment tools during exercise myocardial deformation imaging or 2D Wall Motion Tracking (WMT) has emerged as a potentially suitable imaging modality during stress echocardiography as it allows for direct assessment of myocardial performance. Importantly, some 2D strain parameters such as strain rate are relatively load independent 2 and correlate positively to invasive contractility measurements 3. 2D WMT is also more sensitive to mild functional impairment than traditional echocardiographic functional parameters and can assess regional myocardial function. Image acquisition of 2D...
strain data is time efficient and easy to obtain. Unlike Tissue Doppler Imaging, 2D WMT also shows angle independency, paramount when acquiring echocardiographic images during exercise. Echocardiographic hardware and software however have to be robust and able to allow tracking at high heart rates and challenging conditions during exercise and further development work is required.

Combined, 2D WMT and CPET can provide a comprehensive and direct description of cardio-pulmonary exercise response and might also help differentiate between normal and pathological myocardial function during exercise. Here we present pilot data of a synergistic and time efficient comprehensive assessment of cardio-pulmonary response to incremental exercise, using 2D WMT to assess myocardial function in conjunction with simultaneous assessment of metabolic gas analysis by CPET, in adolescent elite athletes.

METHODS
14 male adolescent professional football academy players (mean age 15.4 ± 0.8 y) underwent echocardiography at rest, during exercise and recovery while completing an incremental CPET on a recumbent cycle ergometer (Fig. 1). Echocardiography at rest was performed following England Football Association screening guidelines. LV myocardial performance was serially assessed during exercise and recovery measuring LV peak systolic longitudinal (LV Sl) and LV peak systolic circumferential (LV Sc) 2D strain. The study was conducted in collaboration with our research partners Toshiba Medical Systems and Manchester United Football Club Youth Academy, UK.

EXERCISE ECHOCARDIOGRAPHY AND 2D WMT
Exercise echocardiography was performed using the Artida for image acquisition and UltraExtend ACP software for 2D WMT analysis. Analysis is also possible using the AplioCV system and the on-board analysis software. A LV focused 4-chamber view (Fig. 2) and a parasternal short axis view (Fig. 3) were captured for 2D WMT analysis at rest, at several exercise stages and at recovery. Three cardiac cycles were acquired at rates of 30–90 frames per second in raw DICOM format and analysis was performed on one manually selected cardiac cycle. The endocardial borders were manually contoured at end-diastole with the range of interest adjusted to include the whole myocardium. Peak strain was defined as the maximal deformation of a segment in systole and represented as a percentage of the original size. Standard nomenclature was used to describe the LV segments and LV peak systolic longitudinal strain recorded for the three lateral and three septal segments. Circumferential peak systolic strain was measured at the

Figure 2: Representative 2D image sequence during exercise for LV Sl. A: rest at HR = 87 bpm; B: 50 W at HR = 90 bpm; C: 100 W at HR = 117 bpm

Figure 3: Representative 2D image sequence during exercise for LV Sc. A: rest at HR = 84 bpm; B: 50 W at HR = 96 bpm; C: 100 W at HR = 99 bpm
base of the LV. Mean or global values for circumferential and longitudinal strain were calculated for each level only if good tracking was obtained in a minimum of four segments. An incremental CPET on a recumbent cycle ergometer to volitional exhaustion was performed by all participants during image acquisition.

ASSESSMENT OF MYOCARDIAL PERFORMANCE BY 2D WMT DURING CARDIO-PULMONARY EXERCISE TESTING

We tested if LV myocardial performance can be quantitatively assessed by 2D WMT during exercise and if 2D WMT can describe myocardial performance during exercise. Image acquisition for 2D WMT was robust up to a power output of 150 W. The performance of 2D WMT during exercise stages revealed several important relationships of cardiac exercise adaptations. 2D WMT analyses showed a linear increase in myocardial performance with increasing power output and exercise stage (Fig. 4). LV peak systolic global longitudinal (Sl) and LV peak systolic global circumferential (Sc) strain showed a linear relationship with significant differences across increasing exercise stages up to 150 W compared to rest (p < 0.01). This indicates that, besides stroke volume and HR increase, intrinsic increase of myocardial performance is an important mechanism of cardiac output increase during exercise.

FORCE-FREQUENCY RELATIONSHIP DURING EXERCISE

LV SI peak also significantly correlated to HR max (r = 0.59, p = 0.03) directly confirming the classic concept of a positive force-frequency relationship (FFR) – a key relationship for the normal adaptation of cardiac function during exercise (Fig. 5).

RELATIONSHIP BETWEEN CARDIAC FUNCTION DURING EXERCISE AND RECOVERY

Cardiac recovery response is an important marker of fitness and we therefore also assessed 2D strain at 2 min and 6 min of recovery and found a significant correlation between LV SI peak and LV SI rec (r = 0.57, p = 0.04) and LV Sc peak and LV Sc rec (r = 0.56, p = 0.04). These findings point towards a direct relationship between myocardial performance during exercise.

**Fig. 4:** Left: LV Peak systolic global longitudinal (Sl) (left) and LV Peak systolic global circumferential (Sc) against power output, with linear regression lines. Right: LV Peak systolic global longitudinal (Sl) and LV Peak systolic global circumferential (Sc) against stage, with linear regression lines. Ten stages as follows: Rest, 0 W = unloaded pedalling, 25 W, 50 W, 75 W, 100 W, 125 W, 150 W, 2 min rec

**Fig. 5:** LV Peak systolic global longitudinal (Sl) (left) and LV Peak systolic global circumferential (Sc) strain (right) in relation to HR with linear regression lines showing a positive force-frequency relationship over different exercise stages
exercise and recovery and this will need to be explored further, as recovery 2D strain parameters could serve as a useful tool in assessing cardiac function and reserve.

**MYOCARDIAL PERFORMANCE METABOLIC RELATIONSHIP**

Our combined methodology also allows for assessment of the relationship between myocardial performance and exercise oxygen consumption. In our small cohort we found only a weak correlation between LV SI peak and LV Sc peak to VO2max, (r = -0.20 – 0.40, p > 0.05) and larger populations will need to be studied to assess the relationship between myocardial exercise performance and metabolic exercise parameters in more detail.

**DISCUSSION**

2D WMT echocardiography during exercise is feasible to describe myocardial performance and in combination with simultaneous CPET can enhance our understanding and interpretation on the complex cardiac and metabolic exercise adaptations during exercise and recovery. To our knowledge this is the first time that the relationship between myocardial performance as measured by 2D WMT and the metabolic exercise parameters have been assessed simultaneously in adolescent elite athletes.

We have determined that LV myocardial performance increases significantly and incrementally through different exercise stages without reaching a plateau. We have also described an accentuated force-frequency relationship during exercise. The exercise force-frequency relationship has not been demonstrated using 2D strain during exercise. Direct measurement of the force-frequency relationship during exercise stress could particularly be of importance to discover early ventricular dysfunction in patients with near normal resting function.

Overall, our data indicate that myocardial performance assessment by 2D WMT is a sensitive and responsive tool for the quantification of cardiac adaptation during exercise and in recovery. The advantage of our combined protocol compared to other methods, e.g., inotropic stimulation or pacing to increase myocardial performance, lies in its non-invasiveness and more importantly has a higher external validity, in that it mimics physical activity and its effect on cardiac performance.

**LIMITATIONS**

It should be noted that 2D strain assesses only unidirectional myocardial deformation forces and cannot therefore capture the complex multi-dimensional and directional cardiac myofibre deformation. We have attempted to address the multi-dimensional LV myocardial deformation by analyzing the two most widely used deformation planes, longitudinal and circumferential strain analysis. The recent development of 3D WMT will allow us to address this limitation in the future. Image optimization during exercise to obtain adequate 2D WMT data should include reduction of artefacts, noise and image window focus with the view to obtain sufficient frame rates.

**CONCLUSION**

Direct assessment of ventricular function parameters by using 2D WMT during exercise can be utilized to directly describe myocardial exercise performance and can overcome the limited predictive value of exercise capacity on myocardial function. In the clinical setting, this protocol could serve as a tool to better quantify myocardial reserve, which is an important concept in patient risk stratification of ventricular dysfunction. Our current study as introduced in this paper will use 2D WMT to compare myocardial performance in three paediatric groups, non-trained but healthy children, elite youth athletes and children with CHD to determine the mechanisms of exercise limitations and cardiac dysfunction in children with CHD.

**ACKNOWLEDGEMENTS**

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**Credits**

Mark Hitchman, Tim Palarm & Mar Howe

**References**


Clinical Added Value from New Technology

German Armed Forces and Patients Benefit from New Options for Low-Dose Volume CT

Dr. S. Waldeck 1)

The Radiologists at the Bundeswehr Central Hospital in Koblenz (BWZK), Germany, used the high-end volume CT - Toshiba’s Aquilion ONE™ / VISION Edition - for several months, along with the Vitrea Advanced web-based image-processing software. The new, low-dose volume CT expanded clinical diagnostics and provided added value for trauma- and routine CTs, as well as special examinations.

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The Diagnostic and Interventional Radiology department comprises of a team of 19 doctors and 24 technicians who work under the direction of Head Doctor, Dr. Stephan Waldeck. The new Volume CT scanner is predominantly employed in the following areas: low dose scans of all body regions and organs (e.g. for diagnosis of accident victims and patients with multiple injuries); for complete diagnosis of heart and brain disease; and in angiography. It is also used for examinations of the face, paranasal sinuses, upper and lower jaw, temporal bones and dental CT. It is used in planning CT guided interventions, e.g. stenting of thoracic, abdominal and carotid arteries and neurological interventions; minimally invasive treatment of tumors as well as targeted pain therapies in the spine.

With 16cm coverage and 640 slices per rotation, the CT system has set a new technological standard, and has created opportunities for a variety of new examinations.

Dr. Waldeck and his Team are excited both by the new technology and the clinically advanced applications options. Examinations can now be performed with the Aquilion ONE / VISION Edition, in which the balance between low dose and excellent image quality is standardized for all patients. The following examples show the added value that volume CT offers routine applications.

Case 1: 64-year-old patient with slightly progressive exertional dyspnea

The patient presented with slightly progressive exertional dyspnea, but otherwise unremarkable symptoms. With no history of smoking, but a family history of coronary disease, the patient was at a low risk for coronary artery disease.

A cardiac CT scan was performed that demonstrated 2 plaques in the proximal LAD. Distal to the first diagonal branch a calcified plaque was seen that was not causing significant stenosis. More distally a second non-calcified plaque was seen at the location of the second diagonal branch. This plaque was determined to be causing a significant stenosis (Fig. 1).

Due to the clear CT findings, a timely cardiac catheterization examination was performed, which confirmed the high grade LAD stenosis (Fig. 2). A stent was then placed and the patient was symptom free after the revascularization.

In particular, the large detector width of the new CT, which is 16 cm, enables high-resolution cardiac imaging, while reducing the radiation exposure of the patient by about 80% (actual dose in cardiac CT: 0.6 to 2 mSv, 1 mSv on average). Artefact-free, diagnostic imaging of the heart and the coronary arteries can be performed, even in the case of cardiac arrhythmias.

After just a few months of using the new CT in the Hospital, the system is widely accepted by clinicians and cardiologists, who have expressed only positive feedback. As part of the evaluation of chest pain, major causes can be ruled out with CT using the 'Triple Rule Out' protocol.

In particular, in a hospital, like the BWZK, where the emphasis is placed on great expertise in cardiology and cardiac surgery, the long-awaited new CT has already met the high expectations of the clinical colleagues.
Case 2: Subarachnoid hemorrhage with hemorrhagic bifurcation aneurysm and acom aneurysm

A comatose patient was brought to the emergency room by emergency services. In a third-party anamnesis, the husband reported sudden extremely intense headaches and increasing disorientation.

The initial Brain CT in the emergency room detected a massive subarachnoid hemorrhage with ventricular rupture. The subsequently performed CTA revealed a large cerebral artery aneurysm in the area of the bifurcation, which was confirmed by invasive angiography and treated (Fig. 2).

The platinum coils used in the treatment of such aneurysms are very susceptible to artefacts in conventional CTs due to the quantity of constituent metal. In particular, an assessment of the vessels and the immediate area is thus, considerably more difficult or impossible (see Fig. 2: CCT without SEMAR vs. CCT with SEMAR in Fig. 2).

The CTA scan was reconstructed with single energy metal artefact reduction (SEMAR) to reduce the artefact from the coils, enabling the contrast to be seen in the aneurysm (Fig. 2).

The 16-cm detector width makes it possible, especially in cases involving such complex issues, to acquire highly-detailed vessel imaging and perfusion measurements in the shortest possible time. The new SEMAR technology also makes it possible to image vessels and cerebral parenchyma elements immediately adjacent to the coiled aneurysm in good diagnostic quality.

In particular, valid vessel imaging in cases involving interventional- or surgically treated aneurysms was not previously possible with conventional devices due to the pronounced metallic artefacts and could only be performed by means of invasive catheter angiography. The combination of whole-brain perfusion with whole-brain angiography and optional artefact suppression (SEMAR), thus, represents an enormous diagnostic advantage.

Case 3: Stroke

The Emergency Room admitted a 53-year-old female patient with acute right-side hemiparesis, which occurred approximately two hours earlier. The patient was immediately taken a CT evaluation for acute stroke which was suspected.
A non contrast brain CT performed on the Aquilion ONE excluded hemorrhag (Fig. 1).

A whole-brain perfusion examination was then carried out with 50ml of contrast. The 4D DSA revealed a occlusion of the left MCA, and analysis of the perfusion examination detected a significant ‘mismatch’ between the infarct core and penumbra in the right centrum semiovale (Fig. 2).

Based on the CT findings and the patients symptoms, subsequent to interdisciplinary clinical conferencing and consultations on site, the patient was immediately taken for catheter angiography, where the vessel occlusion was confirmed, and could then be successfully treated by stent retriever (Fig. 3).

The Toshiba Aquilion ONE, which is capable of performing whole brain perfusion examinations saves valuable time, especially in such cases involving agitated stroke patients. In no other disease is time of such critical importance, as in the case of a stroke, in which the maxim ‘Time is Brain’ applies. Whole-brain perfusion patients can be selectively filtered to determine those, in whom intervention will be able to reperfuse brain tissues, since the still-to-be-rescued but vulnerable brain (tissue-at-risk) can be imaged in an extremely short time.

With regard to the envisaged stroke unit at BWZK, the Aquilion ONE provides radiologists and clinicians with an additional highly effective tool for diagnosing and making treatment decisions in patients with acute stroke symptoms. It has been welcomed into clinical routine by the neurology and intensive care teams.

Figure 1: Non contrast brain CT

Figure 2: Selected axial sections of a colour-coded, whole-brain perfusion CT, with axial perfusion maps showing A, cerebral Blood Flow (CBF), B, Blood volume (CBV), C, Mean Transit Time (MTT), D, Time to Peak (TTP).

Figure 3: Catheter angiogram

Figure 4: Whole-brain perfusion and whole brain angiography in one examination
**Case 4: Hip Replacement with SEMAR**

A 71-year-old woman with a dual right hip prosthesis presented suffering increasing pain post-operatively. Material rupture and significant loosening of the prosthesis was ruled out by means of a conventional X-ray examination.

To detect any soft tissue abscess, a CT scan of the pelvis was performed with IV contrast. The metal prosthesis caused significant artefact preventing evaluation of the surrounding tissues.

A reconstruction with SEMAR was then performed. This reconstruction demonstrated a hypodense structure in the right iliopsoas muscle, immediately anterior to the hip joint with surrounding contrast enhancement. This structure was determined to be an abscess (Fig. 1).

In this clinical situation, the SEMAR technology demonstrated the diagnostic relevance of suppressing metal artefacts due to implants, particularly in the surrounding tissue.

![Figure 1a: Plain X-ray of the hip demonstrating no loosening of the prosthesis](image1a)

![Figure 1b: CT scan demonstrating significant artefact from the metal prosthesis](image1b)

![Figure 1c: SEMAR reconstruction demonstrating the abscess anterior to the hip prosthesis](image1c)

**Case 5: ArterioVenous Malformation in the Right lower leg**

This patient presented with a mass in the right lower leg. A 4D CTA was performed to determine the cause of the mass.

The arterial phase of contrast-enhanced examination revealed a normal perfusion of the leg vessels.

The primary finding was an approximately 2.5 x 1.3 x 5 cm large arteriovenous malformation posterior to the distal tibia and almost 4 cm above the ankle joint. Considering the inundation time, this corresponded to a low flow malformation mainly supplied from two branches of the fibular artery, as well as by a cranially extending branch of the anterior tibial artery. There were, however, multiple small feeders, particularly from the fibular artery.

![Figure 4: The 4D CTA demonstrated the feeding arteries and draining veins of this AVM of the leg.](image4)
Doppler ultrasound is a non-invasive diagnostic tool to evaluate blood flow and hemodynamics. Due to clutter noise and motion artifacts, conventional Doppler has a limited ability to visualize low velocity blood flow. Therefore, Toshiba introduced Superb Micro-Vascular Imaging (SMI) which overcomes the limitations of conventional Doppler by enabling detection of low-velocity blood flow with high frame rates, reduced motion artifacts and high resolution.

SMI is ideal for Pediatric Radiology as the high frame rates and reduced flash artifacts allow for easier acquisitions in active, young children. Also, no intravenous contrast agents are needed during an ultrasound exam with SMI. SMI can serve as a new problem-solving tool in Pediatric Radiology for diagnoses such as vesicoureteral reflux or testicular torsion.

In the latest version of the Aplio™ Platinum Series, Smart 3D is introduced and this further expands the clinical utility of SMI. Smart 3D reconstructs 3D volumes from 2D SMI images using conventional 2D transducers. 3D SMI volumes are easy to acquire by either pivoting a convex transducer or sliding a linear transducer (Fig. 1), without needing to switch to a 3D transducer during the exam.

With only one button, 3D SMI images can be reconstructed immediately. As a result, Smart 3D provides a cost-effective, time-saving solution of creating an entire, three-dimensional vasculature volume. 3D SMI images provide volumes with high resolution of the tissue vasculature with clear visualization of vessel branching and networks.
Case 1: Teenage boy with suspicious shoulder mass

A 19 year-old patient presented with an enlarging, non-tender mass on the anterior aspect of his right shoulder. The patient denied trauma to the area but complained the mass had limited his range of motion in the right shoulder.

X-ray (Fig. 2a) revealed soft tissue fullness but without bony involvement or calcifications. MRI (Fig. 2b-2c) showed a large, enhancing soft-tissue mass abutting the shoulder joint and expanding adjacent muscle bundles. The mass raised suspicions of sarcoma. PET imaging (Fig. 2d) of the presumed malignancy showed mild F18-FDG uptake in the mass but less uptake than would be expected for an aggressive tumor. Strain elastography showed a typical benign pattern (Fig. 2e) and SMI nicely visualized the highly vascular nature of the tumor (Fig. 2f-2g). The feeding vessels and draining veins are outlined in detail using 3D SMI (Fig. 2h), allowing the interventional radiologist to safely plan a percutaneous biopsy. The ultrasound-guided biopsy was performed without any complications or embolization needed and pathology revealed a benign intramuscular hemangioma.

Ultrasound exam served as a useful clinical tool in biopsy planning.
Case 2: 3 week-old infant with a suspected cystic kidney

A newborn infant was diagnosed with a cystic kidney from early gestation. A follow-up ultrasound was performed at 3 weeks of age to determine the status of the kidneys. On the infant’s right side, ultrasound (Fig. 3a) showed no recognizable renal tissue and a normal-appearing adrenal gland. On the infant’s left side, ultrasound (Fig. 3b) showed a normal kidney which was at the upper range of normal in length. The right kidney was presumably involuted during gestation due to high grade obstruction or multicystic dysplasia.

3D SMI images of the solitary left kidney (Fig. 3c-3d) were useful to confirm a healthy kidney and exclude other commonly associated abnormalities, especially ureteropelvic junction obstruction, which is often due to a vessel crossing the renal pelvis. Other associated abnormalities were clearly excluded by the ultrasound exam with 3D SMI, which resulted in a more confident diagnosis for this patient.

**Figure 3a:** Right abdomen of 3 week-old infant showing no recognizable renal tissue

**Figure 3b:** Solitary left kidney

**Figure 3c:** 3D SMI

**Figure 3d:** 3D SMI

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**SMI**

Toshiba’s innovative SMI technology expands the range of visible blood flow and provides visualization of low velocity microvascular flow unseen before with ultrasound. SMI’s level of vascular visualization, combined with high frame rates, advances diagnostic confidence when evaluating lesions, cysts and tumors, improving patient outcomes and experience.
Case 3: Teenage boy with a history of carcinoid tumor

A 17 year-old patient with a history of carcinoid tumor found during appendectomy, presented for follow-up to rule out recurrence or metastatic spread of carcinoid. Although the vast majority of appendiceal carcinoids behave in a benign fashion, they are considered malignant because of their potential for invasion, metastasis and production of physiologically-active substances.

At our institution tumor surveillance is initiated if poor prognostic factors such as nodal metastasis, lymphovascular invasion, mesoappendiceal invasion, or mixed pathology are identified. This patient was scanned with ultrasound and no suspicious areas were seen. SMI was added to the ultrasound examination (Fig. 4a-4c) to improve the detection sensitivity for isoechoic liver metastases. Although the sensitivity of ultrasound in detecting liver metastasis is less than CT with contrast, the ionizing radiation and contrast administration of CT scans is a concern in young patients who may require additional follow-up imaging. Neuroendocrine tumor metastases to the liver can be hyper- or hypo-echoic surrounding liver tissue, but are nearly always hypervascular. Ultrasound examination with 3D SMI improves our diagnostic confidence without having to give intravenous contrast agents or expose patients to ionizing radiation. Smart 3D with SMI enables a quick acquisition from large regions of tissue, like the liver, to display three-dimensional vascular details with high spatial resolution.

CONCLUSION

SMI provides an outstanding capability to detect low-velocity minute vessels. With Smart 3D, 3D SMI images can be reconstructed, providing a three-dimensional view of the target vasculature. The combination of SMI and Smart 3D allow a better visualization of vascular anatomy for improved biopsy planning and diagnostic confidence. 3D SMI has the potential to provide better detection of the crossing vessels in ureteropelvic junction (UPJ) obstructions, better definition of hypervascular tumors and better detection of isoechoic lesions in solid organs such as liver, spleen, and kidney. In addition, 3D SMI may prove useful for assessing blood flow in transplant organs. Smart 3D with SMI delivers an easy-to-use, radiation-free and contrast-free method to improve diagnostic confidence in Pediatric Radiology.
Current Status of Computed Tomography for TAVI Planning

Dr Stefan M. Niehues, Dr Bernd Hamm

TAVI (Transcatheter Aortic Valve Implantation) is a pioneering medical technique that has gained increasing significance in recent years. TAVI is used to treat aortic stenosis, which is the most common heart valve disease in the Western world and especially inflicts patients in the second half of life. Until recently, the primary treatment for aortic stenosis was valve replacement by open surgery.

TAVI IS GAINING INCREASING IMPORTANCE

Clinically expressed aortic stenosis is an indication for valve replacement. The background for this indication is significantly reduced life expectancy without intervention. Due to the generally advanced age at clinical presentation, aortic stenosis often affects a group of patients with various comorbidities. These comorbidities, which include decreased ventricular ejection fraction, COPD (chronic obstructive pulmonary disease) or significant renal failure, but also the patient’s will, age and many other factors, often mean that open surgical valve replacement is not a viable option. Therefore, there is a large group of patients who would benefit from an aortic valve prosthesis, but who do not have access to the ‘classic’ therapy involving an operation. TAVI is aimed at this group.

The first description of TAVI in human subjects was provided by Cribier in 2002. A multidisciplinary expert paper produced by the American Heart Association, the American Society of Echocardiography, the European Association for Cardio Thoracic Surgery, the Heart Failure Society of America, Mended Hearts, the Society of Cardiovascular Anaesthesiologists, the Society of Cardiovascular Computed Tomography and the Society for Cardiovascular Magnetic Resonance, from 2012, confirms TAVI as the treatment of aortic stenosis for patients without the option of surgical therapy. Clinical trials, such as the PARTNER study, have been able to demonstrate that, for the above-described patient group, TAVI is not inferior to open-surgical therapy and exhibits a comparable two-year mortality. Similar
numbers of patients are now being treated with TAVI as with surgical valve prosthesis. Follow-up studies have already been initiated to determine the treatment’s effectiveness for younger patients with medium operative risk. A significant increase in the use of TAVI, is therefore, to be expected.

RESULTS OF TAVI IN RELATION TO COMPARABLE PROCEDURES
A number of risks have been described with regard to TAVI, but also operative valve replacement. The main acute risks mostly concern the rupture of vessels, along with associated hemorrhaging, embolic events and arrhythmias. The implantation may cause thrombotic or calcified material to be moved in front of, or into the outflow of coronary vessels, so that there is a risk of myocardial infarction. Consequently, there is a great deal of debate around the question of whether TAVI may only be performed at special centers, with the involvement of cardiac and vascular surgeons. Unlike in a surgical procedure, it is not possible to directly examine the valve plane, operate and make any required measurements of the vessel, during TAVI. After intervention, the greatest risk involves paravalvular leakage, mostly due to calcium deposits or a mismatch between the aortic root diameter and diameter of the implanted prosthesis.

EXACT TAVI PLANNING REQUIRED
Careful examination of the feasibility and planning of the intervention, along with selection of the correct valve size is, therefore, necessary to reduce the chance of such complications, especially in the case of TAVI. The number and choice of prosthesis is currently still manageable,

PROTOCOL
Scan triggering with SUREStart in the ascending aorta.

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Table 1

Figure 1: 3D imaging of the aorta and its outflows in a patient for TAVI planning. Scan with VHP and 80 ml Imeron® 400.

Figure 2: Valve plane from an angled view. Triggering results in an artefact-free view of the valves and their calcification. Due to the short bolus, the right ventricle is unenhanced.

Figure 3: Curved reformatting of the aorta and the right pelvic and leg vessels for the evaluation of length, tortuosity and diameter. Automatic measurement of diameter (top left) and tortuosity (bottom left). Total DLP for the examination: 713 mGy*cm.
but third-generation TAVI systems are soon expected, and they will address the problem of paravalvular leakage, for example. Depending on the center, different planning modalities are used for this purpose. Since the value and the precision of computed tomography (CT) have now been identified in many TAVI studies, CT has been given a significant role in the planning for TAVI in the 2012 European Guidelines on the management of valvular heart disease.

According to European Guidelines, CT is extremely important for TAVI planning

Depending on the valve manufacturer and applied implantation technique, a series of measurements is required for TAVI, which can be obtained and documented from a single CT data set. Besides defining the valve plane, measuring diameters and determining the surfaces of aortic root and descending aorta, as well as the volume of the position of the origins of the coronary arteries and other measurements, the visualization of the pelvic and iliac arteries is crucial. The measurement and visualization of valve calcifications, possible vascular caliber variation and thrombotic deposits help in the TAVI decision and in the choice of a suitable valve type.

Elegant VHP scanning method: variable helical pitch combines triggered thorax scan with untriggered abdomen CT

The combination of an ECG triggered thorax scan and a untriggered abdominal CT (Variable Helical Pitch, VHP) makes the acquisition of a TAVI-enabled CT dataset possible. This is an elegant compromise, providing an artefact-free view of the valve plane and low dose images of the aorta and iliac arteries (Fig. 1-3, acquisition by the Toshiba 160-slice CT Aquilion PRIME, evaluation and TAVI planning with Vital Vitrea Advanced*).

This technique also involves a one-time administration of contrast media (CM), resulting in the creation of a short, but highly concentrated contrast agent. A possible scan protocol is shown in Table 1 below.

A CM bolus is sufficient

The data thus obtained is loaded into the TAVI evaluation program in the Vitrea software and can hence be systematically analysed in a short time at an ‘acceptable’ cost.

Conclusion

Computed tomography planning for a trans-vascular aortic valve replacement is achieved with high precision and contributes significantly to the success of this innovative treatment method.

Reference

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.

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- Separate, continuous numbered image- and table captions

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