

Heartbeat

The Magazine for Sustainable Cardiovascular Care

March 2015

On the Beating Heart

Intraoperative Imaging
with Mobile C-Arms

A Lab in the ER to
Speed up Evaluation

How Floyd Medical Center
meets the workflow challenges
of the U.S. Healthcare Reform

Less Exposure,
Sharper Images

Interventional cardiology at
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The Portuguese
Pioneers of 4D-ICE

Interventional closure of a left atrial
appendage with real-time 3D guidance

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Answers for life.

Dear Reader,

Healthcare is a “people business.” It’s about the patient and it’s about you, the healthcare professionals. With the ongoing transformation of many major healthcare systems toward value-based healthcare (VBHC), “outcome” is becoming the future currency of this people business. Beyond individual episodes of care provision, payment is increasingly being tied to improved patient outcome. Penalties are being applied more and more for low performance on specific indicators, such as readmission rates or patient safety.

Financial survival in a VBHC environment requires a detailed process and cost analysis of care pathways to identify the true value-adding steps and to remove unnecessary steps. A pathway analysis can also be an opportunity for a disruptive redesign to introduce new procedures that may help improve outcomes while saving costs.

Increasing integration of imaging in the therapy domain is one enabler of such disruptive pathway changes. Numerous new, minimally invasive procedures have been successfully introduced and have improved access, patient safety, and outcomes. Similarly, the use of novel biomarkers in patient triage for high-cost diseases such as heart failure or acute coronary syndrome has both improved outcome and reduced cost.

In this issue of *Heartbeat*, you will read about healthcare professionals from around the world and how they have changed and improved cardiovascular care.

Our cover story describes how intraoperative imaging using our mobile C-arm Cios Alpha helps Prof. Podesser in St. Poelten, Austria, increase access to demanding procedures such as TAVI and endovascular repair in his region.



How can intravascular real-time volume ultrasound imaging (4D ICE) impact the evolution of cardiovascular procedures? To answer this question, we visited two early adopters of 4D ICE using ACUSON AcuNav™ V, Dr. Al-Ahmad in the USA and Dr. Vasco da Gama Ribeiro in Portugal. They describe their pioneering work introducing 4D ICE in electrophysiology and interventional procedures in structural heart disease.

Speaking of patient safety: How can you significantly reduce dose in interventional cardiology while improving image quality? The team at Basel University Hospital shares their recent experience with Artis Q.zen and CLEARstent Live in this issue.

Also, don’t miss our article on Floyd Medical Center in Rome, Georgia, USA. Their redesign of the emergency room workflow based on an integrated diagnostics approach led to a remarkable 62 percent decrease in the readmission rate for heart attack and heart failure – while increasing patient satisfaction and reducing costs.

Amid all the changes and challenges in your work environment, we wish you *more cardiology, less heartache!*

Please enjoy this issue of *Heartbeat*.

Okan Ekinçi, MD, MBA
Vice President
Consulting & Clinical Affairs
Siemens Healthcare



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Moments in which patients' lives hang by a thread require maximum concentration from heart surgeons and their teams. For Prof. Bruno Podesser, outstanding X-ray images and stable power are decisive safety factors. As far as the mobile C-arm Cios Alpha is concerned, he is convinced that "we now have the device which meets our needs."

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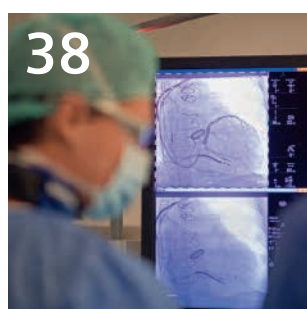
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Cover Story





On the Beating Heart – Intraoperative Imaging with the Mobile C-Arm Cios Alpha

Text: Matthias Manych | Photos: Sven Doering

Moments in which patients' lives hang by a thread require maximum concentration from heart surgeons and their teams. For Professor Dr. med. Bruno Podesser, Senior Consultant in the Cardiac Surgery Department at the Landeskrankenhaus St. Poelten, Austria, outstanding X-ray images and stable power are decisive safety factors. As far as the mobile C-arm Cios Alpha is concerned, he is convinced that "we now have the device which meets our needs."



Prof. Bruno Podesser is specialized in the reconstruction and replacement of the mitral and aortic heart valves.

“With Cios Alpha I can now recognize all the significant structures.”

Prof. Bruno Podesser
Cardiac Surgery Department
Landeskrankenhaus St. Poelten, Austria



Longer life spans and higher quality of life: Bruno Podesser is happy with the advances in cardiac surgery.

One factor which has a significant impact on work in the operating room is encountered by Prof. Bruno Podesser on a daily basis – demographic change. On average, patients in his department are 8 to 10 years older than they were 20 years back. Says Podesser: “The mean age for patients undergoing coronary interventions is 68 years, rising to 72 years in the case of cardiac valve surgery.” And these figures carry some weight, as, with 1,000 heart operations annually, the Cardiac Surgery Department at the Landeskrankenhaus St. Poelten is one of the three largest in Austria. Around 50 percent of patients treated here require surgery on the coronary arteries, while 40 percent are admitted for heart valve replacements and the final 10 percent receive aortic surgery with simultaneous heart valve replacement. The old, frequently frail patients, many of whom are afflicted with countless other comorbidities, greatly benefit from the miniaturization and increasing reduction in operative trauma facilitated by minimally invasive techniques.

More Intervention Options ...

Today, Bruno Podesser is happy to be able to offer more and more patients treatment options which result in both longer lives and a higher quality of life. As an example, he cites patients who “return to us years after a stent graft implantation with three-vessel disease and can still receive bypass surgery”. Further examples include successes with stent grafts in the aorta and the pleasing long-term results experienced with biological aortic valve prostheses. However, many advances in the interest of improved patient care outside of hybrid operating rooms are only possible with the image quality and the technical capacity offered by state-of-the-art mobile C-arm systems. In this context, the cardiac surgeon thinks of meticulous tasks such as the transcatheter aortic valve implantation (TAVI), where it is essential to position the aortic valve

precisely at the level of the body's own valve. “If I am too high, I run the risk of covering the coronary artery exit. If, on the other hand, I am too low, the valve retreats into the ventricle, into the outflow tract, and I am left with a serious complication that can result in the death of the patient,” explains Prof. Podesser. In his view, the spectrum of applications of mobile C-arms like Cios Alpha ranges from the implantation of cardiac pacemakers to transapical and transfemoral TAVIs, carotid angiographies, and the entire stent technology for the major vessels.

... and Improved Quality Checks with Cios Alpha

Intraoperative quality checks have become a matter of course. When performing TAVI, the cardiac specialists in St. Poelten attach the utmost importance to documenting each step via imaging technology – the valve positioning and balloon dilatation as well as the final angiography. Intraoperative angiography is also used as a standard checking procedure for carotid surgery. Cios Alpha can now also be used for this purpose. The new flat detector is not only equipped with 1.5 k by 1.5 k resolution, but also boasts a field of view of 30 times 30 centimeters, which is 25 percent larger than conventional image intensifiers. All decisive structures are now displayed, distortion-free, across the detector's entire surface area.

The high resolution is always of a particular importance if an intervention on the coronary arteries might be required. It follows that, during a transapical heart valve replacement, calcium deposits on the original valve, which were pressed into the vascular wall by the balloon catheter, displace a coronary artery exit. In this instance, stent treatment during the same intervention is imperative. “And there's no question that the improved resolution offered by Cios Alpha is indispensable here,” emphasizes Prof. Podesser. Cios Alpha's rapid image sequence also makes it ideal for use in so-called “beating-heart” surgery.

Intraoperative Imaging in Cardiac Surgery



Precise transcatheter aortic valve implantation (TAVI) with Cios Alpha.

Prof. Podesser, what has changed during the course of your career?

Podesser: It is virtually impossible to equate the situation 20 years ago with working conditions today. Back then, intraoperative imaging was comparable to wandering around in the fog or in a snowstorm. That is why we were so happy with the introduction of metal cores for the pacing wires, as it was the only way to definitely see where we were on the X-ray image. It was extremely difficult to define the boundary between atrium and ventricle. The mobile C-arm Cios Alpha makes this task so much easier.

How does the imaging quality provided by Cios Alpha influence your work?

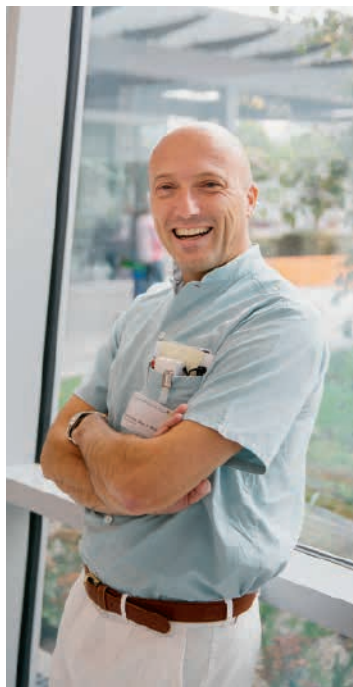
Podesser: We are required to concentrate on the surgical aspects. I can now recognize all the sig-

nificant structures and actually have the luxury of being able to concentrate all my attention on the current operation. Minimally invasive surgery naturally requires us to abandon the safe ground under our feet. A new aspect of intraoperative imaging is perhaps that it now gives us back this lost security via the sheer sophistication of the images produced. Working with Cios Alpha will probably also reduce the operating times. And, above all, patients suffer less, which is the most important thing.

What is your overall assessment of the mobile X-ray system Cios Alpha?

Podesser: The excellence of this device permits interventions during each and every instance of cardiac surgery. We can't ask for anything more right now.

Prof. Dr. med. Bruno Podesser



Bruno Podesser has been involved in cardiovascular research since his student days. Twenty years ago, he founded the Vienna Working Heart Research Group at the Medical University of Vienna (MUW), a lab for young scientists devoted to pure research. The term “working heart” refers to work on an isolated heart simulation. Prof. Podesser learned about this technique in the USA in 1991, and introduced it to Vienna. He has been a board member of the Ludwig-Boltzmann-Cluster for Cardiovascular Research since 2006. His research priorities include the long-term results of biological heart valve replacements and intraoperative heart protection during cardiac surgery. The heart surgeon has been working at the Landeskrankenhaus St. Pölten since 1998. There, his main clinical interests center on the reconstruction and replacement of heart valves, more specifically both the mitral and aortic valves.

The image information contained within each pixel is read out up to 30 times per second.

Cios Alpha is also equipped with a 25-kilowatt generator with a patented, active cooling system. The strength of the X-ray tube provides optimal precision. This is especially important in the imaging of highly obese patients. And the cooling system provides continuous generator power, even during long procedures – a crucial safety aspect for Bruno Podesser. Older C-arms used to switch themselves off relatively quickly, after around 10 minutes’ exposure time, as a measure to protect against overheating. It was impossible to perform TAVI interventions, among other treatments, using the earlier generation of mobile C-arm

systems, as, according to Podesser, the C-arm should not show any weakness when the new aortic valve is positioned. “We no longer have this problem with Cios Alpha. In these moments, the patient’s life is briefly hanging by a thread. If I experienced a technical disruption at this juncture, it would be a catastrophe,” explains the heart surgeon.

Simple Operability, Improved Workflow, Increased Safety

During tests with Cios Alpha for TAVI operations in St. Pölten, Prof. Podesser and his team found the workflow with the mobile C-arm system far more fluid than was the case with previous models. The large field of view permits the entire thorax to be displayed in a single image. As a result, it is no longer necessary to reposition the C-arm for further images, which simultaneously saves on contrast agents. However, if the C-arm does require repositioning, the surgeon can do this quickly and easily on the flat detector housing at the touch of a button. Bruno Podesser also sets great store by motorization. This now allows specific C-arm projections to be saved with the aperture setting and precisely and quickly at a later stage of the procedure at the flick of a switch.

The heart surgeon is very impressed with the slim-line monitor cart’s mobile flat screens – which are very handy in the narrow confines of the operating room – and, above all, the touch screen’s user interface. “The logical structure, which shows the radiological key data on the left, then the patient section, and finally the area to which the actual image refers, makes for highly intuitive operation,” explains a clearly delighted Bruno Podesser. Owing to Cios Alpha, the level of precision and the likelihood of achieving the desired results with an implantation are further boosted by the live graphical overlay. This function permits the valvular level to be marked on the X-ray image during a heart valve

replacement, for example, in order to align the position of the implanted valve as precisely as possible. Prof. Podesser is convinced that “the live graphical overlay function has the potential of becoming a routine instrument of great significance.”

Matthias Manych, a biologist, is a freelance scientific journalist, editor, and author specializing in medicine. His work appears primarily in specialized journals, but also in newspapers and online.

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

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“I can now recognize all the significant structures and actually have the luxury of being able to concentrate all my attention on the current operation,” says Prof. Podesser.

Case Study: Aortic Valve Replacement Due to High-Grade Stenosis Intervention: Transapical TAVI with the Mobile C-Arm Cios Alpha

Condition: Acquired aortic valve stenoses can be triggered by inflammatory processes, natural deterioration or calcium deposits. The case in question involved a valve stenosis in the vicinity of the left flow path of the aorta, which resulted in the left side of the heart pumping against an elevated resistance. The aortic valve stenosis is the most frequent cardiac valve disease in Western countries, and increasingly occurs with age. Around 4 percent of patients over the age of 75 are affected.

Patient: Several years ago, the 83-year-old female patient received two coronary stents and a pacemaker implantation as a result of two-vessel disease. The patient was also suffering from increased airway resistance. Condition pre-op: high-grade calcified aortic valve with severe respiratory difficulties.

Therapy decision: The comorbidities, overall weak condition and high-grade aortic valve stenosis with high postoperative stroke risk resulted in the decision to administer the patient a transapical TAVI.

Intraoperative challenges: Precise positioning of the replacement valve with complete displacement of the original aortic valve on a high-risk patient. The requirements of the imaging system comprised an extremely high resolution with rapid image sequencing and continuous generator output. Subtraction angiography was used to display the coronary artery exits, among other areas, and it supported the drawing of the live graphical overlay. This function is an important orientation tool for the most critical moment of the TAVI intervention: ultraprecise positioning of the replacement valve to allow long-term stability.

Outcome: The verification images produced at the end of the procedure showed that the replacement valve was located in the scheduled position and was normally opening. The supply of oxygen required by the patient was restored successfully, and she was discharged after seven days in hospital.



Cardiovascular Trends



We Have to Learn How to Think in 3D

Dr. Amin Al-Ahmad is pioneering the use of real-time volume intracardiac echocardiography (volume 3D ICE) during electrophysiology procedures with the ACUSON AcuNav™ V ultrasound catheter. In his experience, the accuracy of ablation catheter positioning helps to improve patient safety and the procedure's effectiveness. He expects to get valid data about better measurable outcomes of these procedures in the near future. Dr. Al-Ahmad discussed the impact and future of advanced 3D imaging for cardiac interventions with Heartbeat.

Text: Meredith Knight | Photos: Thomas Steuer



Dr. Amin Al-Ahmad is one of the first electrophysiologists in the United States to use three-dimensional intracardiac echocardiography during atrial fibrillation ablation procedures. Although rigorous studies documenting the benefits of 3D imaging over 2D intracardiac echo imaging have yet not been done conducted, the increased field of vision offered by the new technology creates better visualization of cardiac structures, real time feedback of how ablation affects tissues and the ability to identify complications at the earliest possible moment. It may also expand the types of procedures that can be done without opening the chest cavity and even lead to further development of minimally invasive procedures like closure of the left atrial appendage.

"The ability to do this imaging in real time adds something that we have never been able to imagine doing in the past, having real-time 3D imaging of the heart. This opens up so many possibilities for us," Dr. Al-Ahmad says about his experience with the technology and its further potential in his practice.

Dr. Al-Ahmad has been using 2D intracardiac echocardiography (ICE) for ten years, and began using volume ICE before it was commercially released on the U.S. market in 2012, first at Stanford University Hospital. Dr. Al-Ahmad is one of a handful of electrophysiologists who are able to offer advanced imaging during both cryoballoon and radio-frequency ablation procedures to treat atrial fibrillation patients who are not responsive to first line medical interventions. "I have always enjoyed both seeing new things as well as being part of the development of new technologies that help us advance the care for patients. I enjoy what these technologies can give us in terms of more capabilities. And hopefully that translates to better patient outcomes," Dr. Al-Ahmad says.

Real-time volume ICE increases a physician's ability to visualize the structures of the left atrium and pulmonary veins, and most importantly, their juncture where the majority of atrial fibrillation ablation procedures take place. This allows for the best possible placement of the ablation



The Siemens Ultrasound Innovation Center in Mountain View, California, USA

catheter for the procedure, even in very sensitive locations and across the septum.

During the procedure, the electrophysiologist also gets real-time pictures of the ablation catheter as it is working, visualizing the effect of the procedure on the cardiac tissues in order to control ablation parameter settings for preventing unwanted tissue damage and reducing the amount of radiation needed. Moreover, advanced imaging can detect tissue changes and gas bubble formation via changes in echogenicity. (Source: Calkins)

Clinical implications of volume ICE: Efficiency, accuracy and complication detection

Intra-cardiac echocardiography, in addition to other technological advances, has reduced the timing of pro-

Eliminating anesthesia requirement for valve replacement procedures with 3D volume ICE could further reduce costs and staffing

With real-time volume intracardiac echocardiography, some valve replacement procedures can be done using conscious sedation and local anesthesia rather than general anesthesia, although that decision is often dependent on physician and patient preference. Local anesthesia may add to the value of advanced imaging techniques by

reducing procedure time, although the related clinical impact would be difficult to measure. (Source, Bartel)

Dr. Al-Ahmad thinks the ability to use local anesthesia makes these procedures an option for those patients that cannot undergo general anesthesia because of their health conditions. (Source, Maini)

cedures that could take up to 8 hours in a difficult case before advanced cardiac imaging became the standard of care for EP procedures in the United States.

"The utility of ICE has made these procedures very safe and very routine so that now they typically, from start to finish, might be in the range of 3 hours for a simple-to-treat patient and maybe 4 hours for a more complex scenario," mentions Dr. Al-Ahmad.

Even if the timing of atrial fibrillation ablation procedures is not further reduced with the use of real-time volume ICE imaging, the increased accuracy of catheter placement and ability to visualize target tissue may reduce the need for repeat procedures, a great benefit to both physicians and patients. The real-time 3D images that the ACUSON AcuNav V ultrasound catheter produces has helped electrophysiologists identify complications from the ablation before they escalate.

Cardiac tamponade is an occasional complication from ablation procedures during which a small perforation of the cardiac tissue is made and blood fills the pericardium resulting in a severe loss of blood pressure, poor patient outcome and sometimes death. Using highly specific intra-cardiac imaging allows for the earliest possible recognition of the condition.

"Early recognition of the particular complication is done very quickly with 3D ultrasound and allows initiation of treatment before it becomes critical," Dr. Al-Ahmad explains. ICE has also been shown to provide earlier detection of pericardial effusion. Even though today the vast majority of electrophysiologists already have an echo machine immediately available at the EP lab, only approximately half routinely check for a pericardial effusion following the ablation. (Source: Calkins)

Three-dimensional imaging also allows physicians to see if blood clots have developed on the ablation catheter sheaths, another potential life threatening complication during ablation procedures. This is particularly important for atrial fibrillation ablations, which predominately occur in the left atrium, because of the relative ease with which a clot there could reach the brain and cause severe stroke." By visualizing the heart in real time we can detect clots if they do occur and treat them quickly," says Al-Ahmad.

The ACUSON AcuNav V catheter works with the ACUSON SC2000™ volume imaging ultrasound system, and the cost of the technology still remains comparatively high. This must factor into a physician's decision to adopt the technology and how he or she might best use it in practice. The technology has been deemed easy to use and only requires about 10 to 15 cases before reaching proficiency. (Source: Saad) "The cost of the technology is still relatively high and we need to consider that in today's environment of cost constraints in healthcare. But, I do not think the cost issue is unique to advanced ultrasound technology. I think it's something we have to grapple with for all technologies," Dr. Al-Ahmad states. "We all have to be responsible from that perspective, and I think in our environment and in the future cost is going to be more and more of an issue we have to consider."

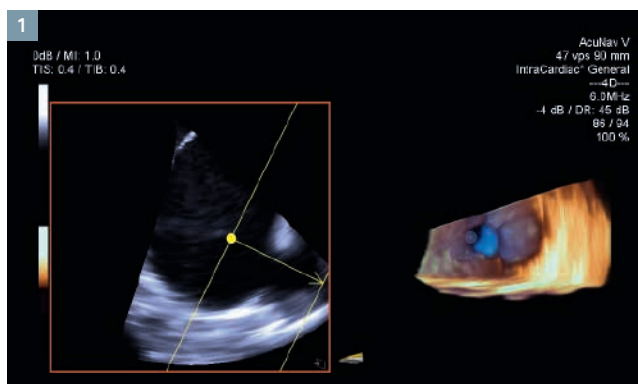
In Dr. Al-Ahmad's opinion, one strategy may be to use 3D advanced imaging on select, difficult cases in which a patient may be undergoing a repeat procedure or have severe disease etiology or other confounding factors that require the best imaging capabilities possible.

However, Dr. Al-Ahmad indicates that in his experience, the accuracy of ablation catheter positioning probably improves patient safety and the procedure's effectiveness. "We all hope that as imaging advances we will have some

"The utility of ICE has made EP procedures very safe and very routine."

Dr. Amin Al-Ahmad, Cardiac Electrophysiologist
Texas Cardiac Arrhythmia Institute
at St. David's Medical Center, USA





1 Visualization of left atrial appendage with ACUSON AcuNav™ V ultrasound catheter



2 Visualization of the catheter tip during transseptal puncture with ACUSON AcuNav V ultrasound catheter

measurable outcome as we have better, more advanced imaging that can transfer to patient outcomes both in safety and efficiency and quality of care. All of that is possible, but we just don't have the data at this point," he says.

Adopting for the future

The real impact of volume intracardiac echocardiography has not yet been realized, according to Dr. Al-Ahmad, who pointed to its possible benefits in procedures that are just beginning to be studied like closure of the left atrial appendage. The small, muscular side pocket to the left atrium is the most common place for clot development in patients with atrial fibrillation. By closing off the appendage, the chance of stroke can be greatly reduced in high-risk patients. "Many of these procedures are under investigation in the United States and we're hopeful that some will become approved in the very near future. But that kind of procedure lends itself to having advanced 3D imaging," Dr. Al-Ahmad says.

Real-time three-dimensional imaging may make the procedure easier, and thus more available to patients who could

benefit. This patient group at high risk of stroke is rapidly growing because of increasing numbers of people with diabetes and hypertension as well as an aging population. Advanced imaging will also drive the development of novel procedures in the near future, as cardiologists are able to realize that potential of the three-dimensional technology and its enhanced resolution within the cardiac space. "We have to learn how to think more in 3D. And that is I think is our biggest challenge in some ways," Dr. Al-Ahmad says.

"People often criticize new technology because it is expensive, or they do not know how to use it yet, or because it's something they're not used to thinking about. I would say what we need to think about is the future of this advanced imaging and how we're going to apply it not necessarily now, but in the next few years. We have to think in terms of the next 5 to 10 years, how will the technology improve, how will procedures going to change and how will the two interact to make things better for patients."

Meredith Knight is a freelance science- and medical writer in Austin, Texas. She received a Master's Degree in Journalism (New York University) and worked as Staff Writer for The Golden Transcript, for Psychology Today and Scientific American Online. She writes daily for The Genetic Literacy Project. Knight received awards like the Colorado Press Association's Best News Story 2008, Best Feature Story 2009, Best Agriculture Story 2009 and Best Series 2010.

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Investing in Routine

Professor Stephan Achenbach, MD, is the Chairman of the Department of Cardiology at the University Hospital in Erlangen, Germany. Smaller hospitals in the region refer patients there specifically for complex interventional cardiology procedures. At the same time, his department provides routine cardiac care for the city of Erlangen, with a population of 100,000 as well as the surrounding area. The University hospital is home to Erlangen's only 24/7 emergency service for interventional cardiology. We spoke to Professor Achenbach about the daily balancing act between routine and advanced interventional procedures.

Text: Hildegard Kaulen, PhD

"A good angiography system provides good images; a very good system provides good images at low radiation dose."



"I see our new Artis one installation as a sound investment in routine."

Professor Stephan Achenbach, MD,
Head of the Cardiology Department,
University Clinic in Erlangen, Germany

Prof. Achenbach, has the spectrum of interventional cardiology procedures changed in recent years?

Of course. Today, we routinely carry out procedures that were simply not possible in the past. This includes transcatheter aortic valve implantation and transcatheter closure of the left atrial appendage to name just a few. Currently, we are even seeing the first catheter-based mitral valve replacements. The spectrum is constantly becoming broader as new techniques and approaches are being developed. However, it is very hard to predict what the mix of basic as compared to very complex procedures will be in typical cardiac catheterization laboratories just a few years from now. Even though you may hear many interventionalists ask "where have all the type A lesions gone?", routine procedures still clearly dominate the workload – and this is the case for every interventional cardiology program, including my own department. In our country it would not be possible to focus an entire program solely on complex

procedures. In many cases they would not even be adequately reimbursed.

From your point of view, what constitutes a complex procedure and what is routine intervention?

While every intervention that initially seemed "routine" can unpredictably turn into a complex case at any time, I would draw a somewhat arbitrary line at chronic total coronary artery occlusions.

Were the situation to arise, would it be preferable to have separate rooms for complicated procedures and routine catheter interventions?

Certainly. That would make it easier to manage the case-load of the day. Not every patient who needs a cardiac examination requires a high-end system. Actually, for routine procedures, having to operate a very elaborate system may even be a distracting. For example, when the user is

not fully familiar with the angiography system and interaction is not intuitive. Routine procedures are all about working quickly, safely and efficiently. It is patient throughput that counts. On the other hand, in the case of complex procedures, it is important to be able to take the time needed and not to feel under pressure because the next procedure is waiting in line.

What are the requirements for routine coronary interventions?

Users should immediately feel comfortable in the cath lab and be able to orient themselves quickly. Operating the angiography system should be easy and intuitive. Nobody wants straightforward procedures to be delayed by complicated menu selections. On the other hand, image quality will always be crucial. One should never assume that routine interventions do not require excellent image quality.

Why is image quality so important in cardiology?

Good image quality is a prerequisite for working safely and efficiently. With poor quality images, you run the risk of provoking mistakes and complications. Contrast-rich images with good spatial and temporal resolution help us to make the correct clinical decisions. Anyone who has become used to a particular standard would in any case find it difficult to put up with less during routine procedures. When it comes to image quality, every user has a comfort zone which he or she is reluctant to compromise. In addition, something else is important: a good angiography system provides good images; a very good system provides good images at low radiation dose.

Which software tools do you appreciate, besides the applications for reducing radiation exposure?

Post-processing tools do play a role. Some of the stents we now use are very delicate and therefore difficult to see. Tools that enhance stent visibility are extremely useful. For example, CLEARstent and CLEARstent Live allow you to reconfirm that the stent is fully expanded and was placed properly, or that the spacing of two adjoining stents is correct.

An intuitive user interface makes your work safer and more efficient. Do you see additional advantages?

An easy to learn and intuitive user interface is also certainly advantageous if several rotating teams use the same system, or if a broad procedure mix is being performed. And this is not just the case for smaller hospitals. Larger hospitals can, for instance, consider starting a peripheral program if cardiac procedures would not occupy an additional angiography system at full capacity. This way, the case mix is improved.

Would you see more flexible C-arm positioning as an advantage?

When I think about it, I can see numerous relevant advantages. At the moment we have a situation where the space around the patient's head is occupied by the C-arm. For procedures involving an anesthesiologist, this is where he or she would optimally be positioned. Also, as procedures

become more sophisticated, the need for extra equipment – for example, various imaging modalities – in the cath lab increases. However, for this kind of support, you need to have enough room around the table, and the most valuable “real estate” is definitely close to the patient's head and chest. It would therefore be really useful to be able to flexibly position the C-arm around the patient. In an emergency, being able to rapidly move it out of the way and far to the side may be crucial.

How important are space efficient angiography systems and a quick installation process?

Space is always limited in a hospital – in every department, wherever it is in the world. Therefore, it is an advantage when a new or additional angiography system requires only little space. Naturally, it also makes a difference whether the installation process takes six weeks or just a couple of days: not just because of the immediate impact regarding procedures that would be missed. When a cath lab is out of action for a long time, cooperation with referring physicians can suffer. They may start referring their patients to other places, and the consequences of this can be long-term.

In your opinion, what advantages does the new Artis one offer?

Users are very satisfied when they can orient themselves quickly and work efficiently: when they are provided with good image quality; when they find useful tools at their disposal that they really need, and when the radiation exposure for them and their patients is as low as possible. In these respects, the Artis one system has a lot to offer.

What are your expectations?

We are very excited. I see our new Artis one installation as a sound investment in routine. In the future, I continue to expect the majority of procedures there, and many of the procedures that we see as complex today will soon become standard, as well. It has always been this way. That is why I am so convinced that it is important to invest in a cath lab which will provide an optimal environment for my department's everyday challenges.

Hildegard Kaulen, PhD, is a molecular biologist. After holding positions at the Rockefeller University in New York and the Harvard Medical School in Boston, she became a freelance science journalist in the mid-1990s. She writes for a number of respected newspapers and science magazines.

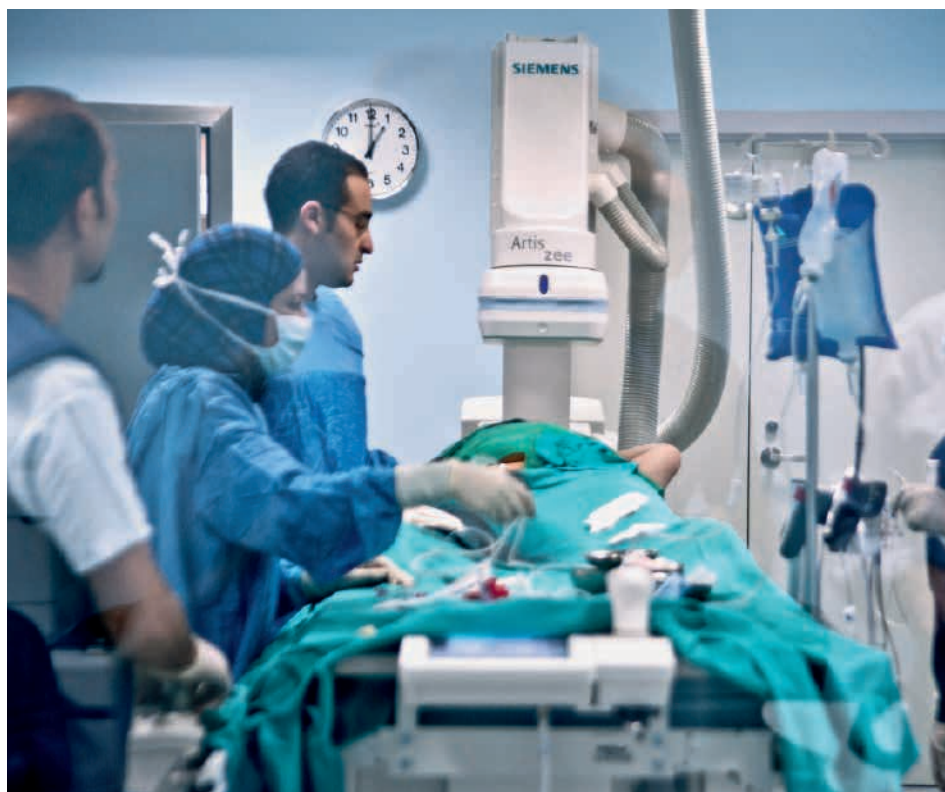
The outcomes achieved by the Siemens customers described herein were achieved in the customer's unique setting. Since there is no “typical” hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that others will achieve the same results.

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EHC Global Forum in Collaboration with Siemens for a Humanitarian Purpose in Aswan

Text: Courtesy of Ahmed ElGuindy, MSc, MRCP, Division of Cardiology, Aswan Heart Centre, Aswan, Egypt, Magdi Yacoub, FRS, Harefield Heart Science Centre, National Heart and Lung Institute, Imperial College London, UK, and Roberto Ferrari, PhD, European Heart for Children Global Forum, Italy



Like many Egyptian cities, Aswan has many attractions for the enjoyment of tourists, but there is more to life in Aswan. For the majority of the local population, life is a struggle against poverty. This is particularly the case for those families who have children suffering from congenital heart disease. Until recently they did not have access to the necessary treatment that would give their children a healthy future, but in April 2013, a collaboration changed all of this.

The second phase of the Aswan Heart Centre (AHC) from Magdi Yacoub Foundation (MYF), together with the Chain of Hope and the European Heart for Children Global Forum, has officially opened. The modern state-of-the-art Heart Center offers adults with CV diseases and children with CHD treatment, all free of charge. The AHC is a compact, four-floor building that meets the highest international standards and offers all the subspecialties in cardiology such as cardiovascular imaging suite interacting echo, fully upgraded cardiac cath labs, and cardiac surgery rooms. Furthermore there is a pediatric intensive care unit and new outpatient clinic that preserves the dignity of the patients and their family members, while at the same time offering them the necessary comfort.

11,000 patients have been examined in the outpatient clinic. 1,326 cardiac catheterizations and 783 open heart procedures have been performed, of which 40 percent were pediatric procedures. Here we describe a case of a myocardial bridge in a young adult with hypertrophic cardiomyopathy: using coronary pressure measurements to guide decision-making.

Patient History

A 24-year-old female presented with a two year history of progressive shortness of breath and exertional angina, especially after meals.

Diagnosis

Physical examination was unremarkable apart from an apical fourth heart sound and a systolic murmur over the left sternal border that did not radiate to the neck vessels. A 12-lead electrocardiogram showed left ventricular hypertrophy and strain. Echocardiography showed asymmetric left ventricular hypertrophy with a maximal thickness of 22 mm at the basal interventricular septum, systolic anterior motion (SAM) of the anterior mitral valve leaflet and a resting peak systolic gradient across the left ventricular outflow tract (LVOT) of 92 mmHg consistent with the diagnosis of hypertrophic obstructive cardiomyopathy (HOCM). The patient had no family history of hypertrophic cardiomyopathy (HCM) or sudden cardiac

death (SCD). Genetic testing revealed a myosin-binding protein C Glu-441Lys missense mutation. A two-month trial of bisoprolol – titrated up to 7.5 mg/day – failed to improve her symptoms. Accordingly, surgical septal reduction therapy (extended septal myectomy) was advised.

Treatment

Preoperative coronary angiography – which is routinely performed as part of pre-myectomy work-up at our institution – revealed a myocardial bridge affecting the mid-segment of the left anterior descending (LAD) artery with near-complete obliteration of its lumen during systole that apparently did not continue into diastole. Three septal perforators arising from the mid-segment of the LAD artery showed similar complete “squeezing” during systole (Fig. 1). Thermodilution-derived coronary flow reserve (CFR) – measured invasively using a pressure/temperature sensor-tipped 0.014-inch wire (Radi PressureWire™ – St. Jude Medical, Inc.; St. Paul, Minnesota) and dedicated software (Thermo™ package) was significantly impaired in the LAD territory (1.23). The index of microcirculatory resistance (IMR) – measured using the same wire and software package – was also abnormal (53), denoting significantly elevated microvascular resistance which – on its own – can explain the blunted CFR values. Conventional fractional flow reserve (FFR) in the LAD was 0.91, however, diastolic FFR (derived from diastolic rather than mean aortic and distal LAD pressures) was 0.75 (Fig. 3). A decision to perform surgical unroofing and full mobilization of the tunneled segment of the LAD artery during extended septal myectomy was made based upon the above findings.

Repeat coronary angiography four weeks after surgery revealed complete relief of the mobilized segment of the LAD artery – with no obliteration during systole (Fig. 2). Repeat CFR, IMR and diastolic FFR measurements showed significant improvement – measuring 1.7, 21 and 0.98 respectively (Fig. 3). Six months after surgery, the patient reports significantly improved exercise capacity with complete freedom from angina symptoms.

Discussion

Myocardial tunnels are frequently encountered in patients with hypertrophic cardiomyopathy with a reported prevalence of up to 40 percent in some post-mortem series [1–3]. The incidental finding of a myocardial bridge on coronary angiography does not seem to carry an adverse prognosis or increased risk of SCD in this patient population [3], [4], and accordingly should not on its own warrant intervention [5]. However, in patients with HCM and myocardial bridging presenting with angina as a prominent complaint, the physiological significance (i.e. ischemic burden) of such a finding should be carefully evaluated. Accurate identification of the small subset of patients with ischemia-producing myocardial bridges followed by surgical management improves symptoms considerably [6], [7] and may arguably reduce the risk of SCD [8], [9]. Establishing a causal link between the presence of a myocardial bridge and regional ischemia might prove to be a difficult task in this setting however.

Angiographic features of myocardial bridges including length of the tunneled segment, degree of systolic compression, and depth within the myocardium are not reliable predictors of their potential to cause ischemia [10]. In addition, conventional angiography frequently fails to identify persistence of epicardial compression into variable periods of diastole (and hence more likelihood of causing ischemia) compared to other modalities such as intravascular ultrasound and intracoronary Doppler flow velocity measurements [11]. It is therefore not advisable to rely on coronary angiography only to determine the physiological significance of myocardial bridges except in cases with very mild compression that is unequivocally limited to systole [7]. Results of myocardial perfusion imaging on the other hand may be of factors in this subset of patients, including the presence of diffuse subendocardial ischemia, extensive microvascular disease, severe compression of septal perforators as well as patchy fibrosis, and should

therefore be interpreted with caution [12–14].

FFR has recently emerged as a simple, accurate, highly-reproducible and lesion-specific index of the physiological significance of fixed epicardial coronary stenosis, with strong evidence supporting its correlation with clinical outcomes [15–21]. Its value in patients with “dynamic” epicardial coronary disease such as myocardial bridging is much less studied and remains limited to a few small series and case reports [22], [23]. Furthermore, conventional FFR measurement – defined as the ratio of mean pressure distal to a lesion to mean proximal/aortic pressure – in the setting of coronary bridges is prone to fallacies related to cyclical changes in coronary flow and distal pressure. The “squeezing” of the blood column distal to bridged segment against a highly resistive micro-circulation (during systole) causes overshooting of the distal coronary pressure compared to the proximal/aortic pressure resulting in a negative pressure gradient across the myocardial bridge during systole. This surge in distal intracoronary systolic pressure increases the mean distal coronary pressure and consequently (falsely) increases the FFR values. In some instances, non-physiological values of >1 are obtained due to this phenomenon. This has been frequently referred to as “the FFR paradox”. To overcome this limitation, the ratio between diastolic pressures – rather than mean – has been proposed to evaluate the physiological significance of epicardial stenosis. This is demonstrated in the present report where “conventional” FFR was 0.91 while diastolic FFR was 0.76. This approach offers the added theoretical advantage of limiting evaluation of the effect of myocardial bridges to diastole, the period where coronary blood flow predominantly occurs.

The additional use of incremental doses of i.v. dobutamine to increase contractility and heart rate can further enhance the diagnostic yield of this technique by simulating the effects of exercise on the myocardium and consequently augment the “squeezing” of the bridged segment prior to pressure measurements [22]. The use

of dobutamine was not deemed necessary in this patient given the low “non-augmented” diastolic FFR value. Successful surgical relief of the tunneled LAD segment led to normalization of diastolic FFR with restoration of concordance with “conventional” FFR measurements, which further supports the theory of the “FFR paradox”.

Conclusion

Myocardial bridges are frequently encountered in patients with HCM and are inconsequential in the majority of cases. However, it is crucial to accurately identify the small subset of patients where the presence of such bridges is associated with regional myocardial ischemia. Diastolic FFR measurement is a simple and highly reproducible tool that can reliably quantify the functional significance of such lesions in patients where the symptom pattern and/or angiographic features raise suspicion about their clinical significance.

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

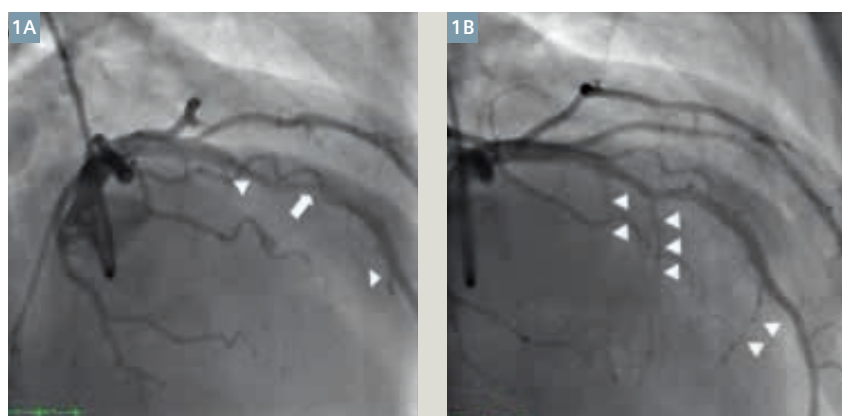
The mission of the center:

1. Offering state-of-the-art medical services to the Egyptian people, particularly the underprivileged and vulnerable age-groups. All services are free of charge.
2. Training a generation of young Egyptian doctors, nurses, and scientists at the highest international standards.
3. Advancing basic science and applied research as an integral component of the program and promoting biomedical research in Egypt.

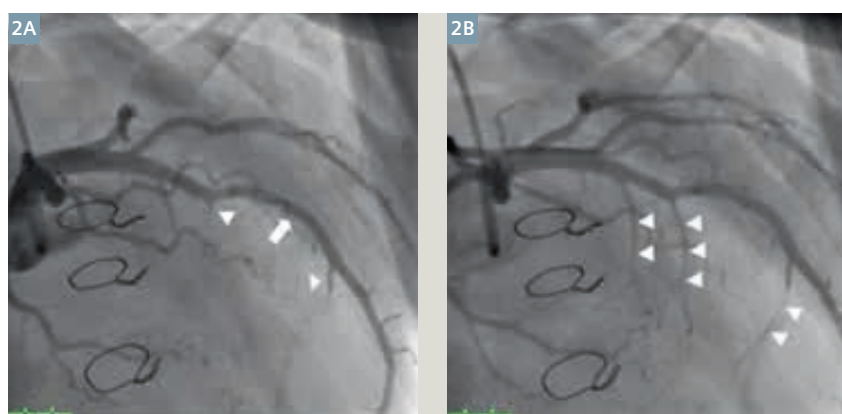
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1 Pre-operative coronary angiogram. Still images in the RAO cranial projection are shown. The mid segment (arrow) of the LAD shows near-total obliteration at end-systole (A) and appears completely unaffected during end-diastole (B). Septal perforators arising from the mid are also squeezed during systole leading to complete obliteration of their lumen (arrow heads).



2 Post-operative coronary angiogram. Still images in the RAO cranial projection are shown. The mid segment (arrow) of the LAD is fully patent during end-systole with no residual systolic obliteration (A) compared to end-diastole (B). Systolic obliteration of the septal perforators remains unchanged (arrow heads).



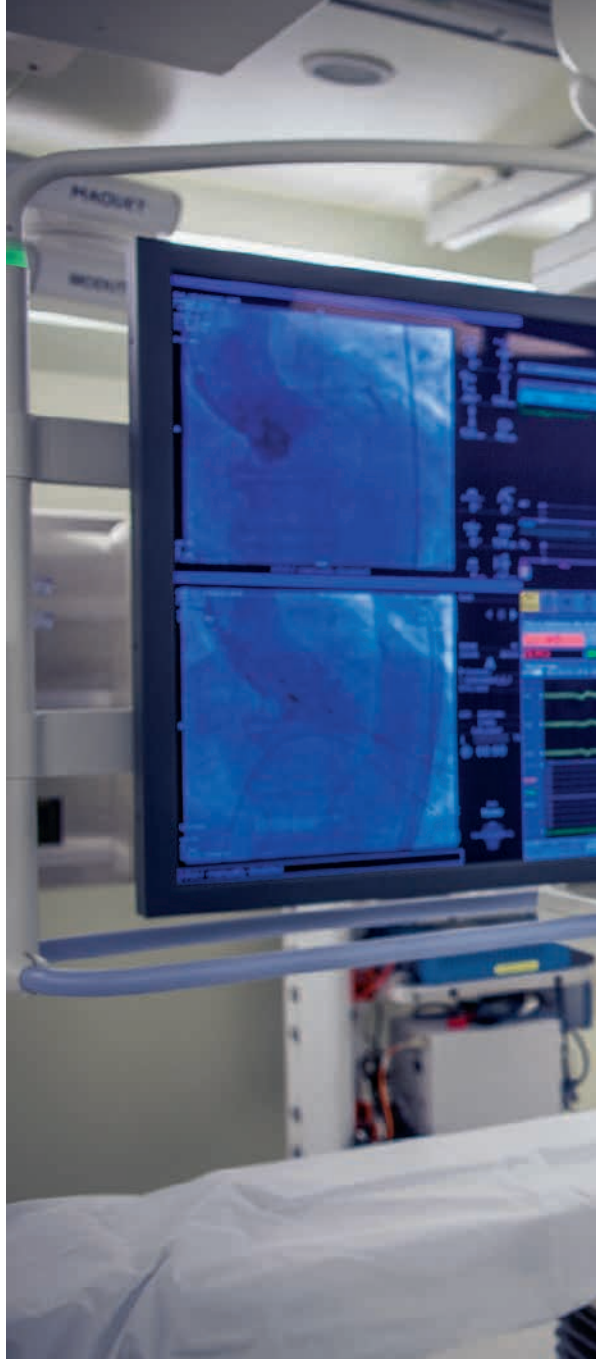
3 Pre- and post-operative coronary pressure measurements as thermodilution-derived coronary flow reserve and microcirculatory resistance measurements. Pre-operative (A) FFR calculated from mean pressures (FFR_{mean}) was 0.91, however, when diastolic pressures were used, FFR was 0.75 (FFR_{dia}). Post-operative (B) FFR_{dia} was 0.98 which is very close to FFR_{mean} calculated at the same time suggesting complete relief of systolic squeezing. Thermodilution curves at basal conditions and after induction of steady-state maximum hyperemia are also shown in both the pre- and post-operative studies along with the derived CFR and IMR values.

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“Some Colleagues Called Me Crazy”

Text: Dr. Chul Joong Kim | Photos: Thomas Steuer



Over the last decade two paradigm changes have occurred in the management of patients with Coronary Artery Disease. It has been acknowledged that only coronary stenoses with hemodynamic significance benefit from revascularization, either PCI or CABG. Previously, most physicians believed, that a stenosis grade of >50 percent was a good reason to undergo coronary revascularization. The second change relates to therapy of left main disease. Here, interventional revascularization has increasingly become an alternative to bypass surgery. In Seoul we visited one of the visionaries, Korean cardiologist Professor Seung-jung Park. Heartbeat spoke with him about the latest achievements in cardiology and how to calm critical colleagues.



Prof. Seung-jung Park was awarded Korea's Top Scientist Award by the Ministry of Education and Science in 2011.

The fastest way to meet cardiologist Prof. Seung-jung Park would be to suffer from acute heart attack. When I visit his office at Asan Medical Center in Seoul he greets me in the gown and surgical cap he wears during cardiac interventions. His words and movements have the rhythm of a heartbeat.

When and why did you become internationally known in interventional cardiology?

It was in 2003, when my article "A Paclitaxel-Eluting Stent for the Prevention of Coronary Restenosis" was published in NEJM. This multi-center study involving three Korean heart centers demonstrated that the coronary restenosis rate could be reduced from 27 to 4 percent when using a paclitaxel-eluting stent instead of a bare metal stent. (N Engl J Med 2003; 348:1537-1545).

You have questioned established procedures and introduced new treatments. How has that been acknowledged by your peers?

In the mid-1990s, I performed stenting of left main (LM) coronary artery, until then a domain of coronary bypass surgery. Thus, LM intervention was met with skepticism at the time.

How did you overcome this strong opposition?

At cardiology congresses I discussed this new approach to left main disease with cardiac surgeons. Initially a lot of skepticism encountered, as our approach was revolutionary. Some colleagues even called me crazy.



By the end of 2013 Asan Medical Center, as the first Asian institution, had performed more than 100 TAVI procedures with a 94 percent procedural success rate.



As criticism got louder, the Asan Medical Center temporarily prohibited the procedure. Only later, when further results had been published in the Journal of the American College of Cardiology (JACC), the situation began to turn around and Asan allowed the procedure again. Now, 95 percent of patients with significant coronary artery stenoses at Asan Medical Center are treated with interventional procedures. I am gathering the results of procedures from leading heart hospitals from all over the world. And in the end, medical guidelines have changed. However, I also became notorious for reducing the size of the cardiac surgical team. (laughs)

What is the next challenge for you?

I am looking for a way to identify those patients with coronary artery stenosis who will not benefit from coronary revascularization. Now I will be the doctor who downsizes his own cardiology department. However, if that helps patients, it should be done.

Can you elaborate?

A hot topic in interventional treatment of Coronary Artery Disease (CAD) is fractional flow reserve (FFR), and that is my interest these days. In other words, when there is no blood pressure drop distal to a coronary stenosis, there is no indication to perform coronary revascularization, neither percutaneous coronary intervention (PCI) nor Coronary Artery Bypass Grafting (CABG). According to literature, this is true in up to 30 percent of patients. In 2009, I realized

that even a high-grade stenosis does not necessarily induce myocardial ischemia in the dependent myocardial segment.

This was an amazing discovery. Approximately one third of those patients whose coronary artery had narrowed by 50–80 percent showed normal FFR results, which means they did not need coronary revascularization. I also learned that on the other hand, coronary lesions with a low stenosis grade could induce myocardial ischemia, demonstrated by a pathologic FFR value.

So, what did you do with this finding?

I published my findings in 2011. Some colleagues criticized it as “nonsense”. In November 2013, we published a big series in European Heart Journal (EHJ). Observing 5,000 angina pectoris patients revealed that those who did not receive procedures or surgeries based on good FFR results showed much better outcomes than those who received procedures or surgeries only based on stenosis grade.

The number of coronary interventions in your hospital has been reduced by half. Is it because you base your decisions on FFR results?

Correct. We changed the approach to management of coronary stenosis. Before, we, like all cardiologists all over the world, performed PCI in coronary lesions with >50 percent stenosis grade. However, nowadays we additionally assess the hemodynamic relevance of such lesions through FFR. And we only perform PCI in lesions demonstrating pathological FFR.

The Korean innovator in cardiology

Cardiologist Professor Seung-jung Park was named “Doctor of the Year” by the European Association of Cardiovascular Intervention in 2005. In 2008, he was the first Asian cardiologist to receive a Career Achievement Award from TCT. He is now on the editorial boards of four international journals. In addition, he was awarded Korea’s Top Scientist Award by the Ministry of Education and Science in 2011. He has been President of Asan Medical Center Heart Institute since 2009 and is currently Chairman of the Cardiovascular Research Foundation.

Professor Park has been using Siemens angiography systems for a long time, introducing the AXIOM dBC and dTC systems in the 2000s and the Artis zee floor-mounted system in the 2010s, frequently applying them in his procedures and achieving remarkable academic outcomes which received international attention. Recently, the Artis zee ceiling-mounted system was installed at Asan Medical Center.

So not all patients with coronary stenosis lower than 50 percent have to undergo coronary revascularization if FFR results are good?

Exactly. And this is also true for coronary bypass surgery. Examining FFR is a win-win model that maintains health and reduces high medical costs for the patients, like it could nicely be demonstrated in the FAME¹ study.

This is a change in CAD therapy. Are there any objections?

There certainly could be. FFR is a new diagnostic approach, and the long-term outcome of patients undergoing FFR-guided coronary revascularization needs to be investigated. Two years of results of FAME are very promising.

Since the introduction of Transcatheter Aortic Valve Implantation (TAVI), Asan Medical Center has performed increasing numbers of these procedures. Do you consider TAVI to be a game changer?

TAVI has meanwhile been done in around 80,000 patients worldwide. Numerous clinical studies like PARTNER or registries comprising tens of thousands of patients demonstrated that TAVI is a safe and effective therapeutic option in patients with severe aortic valve stenosis that cannot undergo surgical valve replacement because of too high surgical risk. By the end of 2013 Asan Medical Center, as the first Asian institution, had performed more than 100

TAVI procedures with a 94 percent procedural success rate. Unlike traditional open-heart surgery, which replaces the diseased aortic valves, in TAVI an aortic valve prosthesis is placed via an arterial access route or a transapical access route in the aortic valve region, after the stenosed valve has been destroyed in the first step of the procedure by balloon angioplasty.

Is not there an overlap between the patients who need TAVI and those who need surgery?

At the moment, when following the guidelines there is no overlap. The average age of those 100 patients who underwent TAVI at our institution was 78 years. Because of too high risk, open heart surgery was not an option for them. Some patients who underwent TAVI were even in their 90s. TAVI is also performed in our hybrid operating room. The hybrid operating room is a top-notch medical facility incorporating a fully functional cath lab system in a fully functional OR. Now we are one step closer to being called a global heart center.

Dr. Chul Joong Kim, holds a doctorate in Medicine and a Master’s degree in journalism. He is a senior staff writer on medical affairs and health information for Chosun Ilbo, a national daily newspaper, and President of the World Federation of Science Journalists (WFSJ).

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

¹ N Engl J Med. 2009;360(3):213-24.

A Lab in the ER to Speed up Evaluation

Text: Silvia Sanides | Photos: Thomas Steuer

U.S. Healthcare Reform is forcing hospitals to reassess their protocols and engineer their clinical workflow processes differently than before. An efficient workflow with early and accurate diagnosis should reduce costs, decrease readmission rates, and improve patient satisfaction. The Floyd Medical Center in rural Georgia meets the challenge with integrated diagnostics for evaluation of patients with chest pain.



A bright green building facade greets visitors to the Floyd Medical Center from afar. That is only one of many features contributing to the friendly atmosphere of this 304-bed hospital in Rome, Georgia. The freshly mulched flower beds are impeccably maintained, a grand piano in the lobby invites patients, staff and visitors to play up a tune, colorful posters, dangling from hallway ceilings, sway in the breeze and remind passersby to "call 911 when you have chest pain". Floyd is determined to keep up the positive spirits, while meeting the daunting new challenges of healthcare reform.



Floyd Medical Center serves a population of 350,000 in the rural, northwestern corner of Georgia.

The multiple demands of the Affordable Care Act (ACA), passed in 2010, put enormous burdens on hospitals like Floyd. The Medical Center serves a population of 350,000 in the impoverished rural, northwestern corner of the state. Georgia has opted out of the ACA Medicaid expansion program, which provides health insurance coverage for most of the poor. "We face new demands, but the number of poor, uninsured patients, unable to pay, will remain unchanged", explains Alison Land, Vice President at Floyd. Insurance reimbursement penalties under the ACA, which punish hospitals for exces-

sive readmissions or lack of compliance with increasingly strict standards of quality of care, are especially painful for places like Floyd.

In spite of the pressures, Land could not be more upbeat: "We anticipate changes here. We are ready for the future, thanks to constant vigilance and improvements". Her obvious enthusiasm for making Floyd a better place has deep roots. She was born in the hospital and both of her parents worked here as physicians. "Floyd is in my family's blood but I preferred to not work directly with blood", she

laughs. Instead she chose a degree in healthcare management and joined the Floyd staff 15 years ago. These days she helps oversee the hospital's difficult transitions under healthcare reform.

Recent improvements in the emergency department (ED), target the diagnosis and treatment of that most costly of indications: Cardiovascular disease (CVD). CVD costs the U.S. \$475 billion each year. At Floyd and most other EDs chest pain, a frequent symptom of heart attack, is the second most common reason for patients'



In 2012 Floyd added a STAT lab to its emergency department:
A Siemens Dimension EXL 200 Integrated Chemistry System



*“We anticipate changes here.
We are ready for the future,
thanks to constant vigilance
and improvements.”*

Alison Land
Vice President for Ancillary Services,
Floyd Medical Center, Georgia

visits. Yet in about 60 percent of admitted cases the symptoms turn out to be of non-cardiac origin, resulting in avoidable annual costs of approximately \$8 billion. These expenses are decreased, when physicians are able to distinguish early and accurately between patients with heart attack and those with other conditions.

No Waiting Time with Chest Pain

Floyd recently acquired the tools necessary to rule out non-cardiac patients at an early stage with a high degree of confidence. When patients visit the ED with chest pain today, everything is in place for their instant medical attention. There is no waiting time, they are put into a bed immediately, an initial ECG (electrocardiography) is performed, phlebotomists draw blood upon starting an IV, cardiac biomarkers are measured on the premises and the data made available to the attending physician within minutes. If signs point to acute coronary syndrome, patients are rushed to the cath lab for reperfusion therapy. In one memorable case just 33 minutes passed, between the time a patient entered the ED and removal of the obstructing clot with balloon angioplasty. Patients in a “grey area” of



The lab in the emergency department has been a decisive factor in speeding up evaluation of patients presenting with chest pain.

indeterminate diagnosis undergo a stress test or are transported to another clinic for a cardiac CT.

Floyd recently acquired the tools necessary to rule patients in or out rapidly with a high degree of confidence. A typical case is that of a 54-year-old woman, who arrived at the ED by ambulance one morning. The account manager at a local engineering company had been working at her computer, when she experienced sudden chest pain, felt dizzy, nauseated, and started sweating profusely. At Floyd, everything was in place for her instant care:

- The patient was put into a bed immediately and doctors performed an initial ECG.
- Phlebotomists drew blood upon starting an IV.
- The specimen was processed and tested for cardiac biomarkers in a lab, conveniently located in the ED. Within minutes the data were available to the attending physician.
- In this case the ECG and elevated troponin levels pointed to an acute coronary syndrome.

- She was rushed to the cath lab down the hall, where doctors initiated balloon angioplasty and placed a stent into the obstructed artery.

In this remarkable case, just 33 minutes passed between the time the patient entered the ED and removal of the obstructing clot. The patient was released from the hospital two days later but her care did not end there. A nurse from Floyd called her at home to make sure she was taking the prescribed medications and reminded her of her follow-up appointment with her primary physician. The patient has since followed her doctor's advice. She watches her diet, exercises regularly and has lost twenty pounds.

Time is Heart Muscle

Such rapid passage through the system was hardly possible before January of 2012. At that time Floyd added a STAT lab to its ED. There had been some difficult decisions to be made. "We are essentially landlocked here; expanding the square footage of the facilities was not possible. We wanted to add a lab but did not really have the space, nothing seemed to fit", explains Land. The solution: A Siemens

Dimension® EXL™ 200 Integrated Chemistry System, which has a very small footprint.

The ED-STAT lab performs a troponin immunoassay which considerably improves sensitivity and precision compared to conventional assays. Therefore, cardiac troponin I levels can be detected at much lower levels remarkably increasing confidence in the results.

Both professional laboratory and clinical organizations recommend the use of these precise and sensitive tests, which deliver reliable results with low sample volumes and can, under some circumstances, detect areas of cell death as small as a single gram. As another plus at Floyd, the ED-assays correlate with those performed by a larger Siemens system (Dimension Vista® 1500 Intelligent Lab System) in the central lab, where in-patients' specimens are sent. "For our physicians this harmonization of methodology is vital. They trust the results because they can directly compare values for patients who transition from the ED to in-patient," explains laboratory director Dianne Nichols.

The lab in the emergency department has been a decisive factor in speeding up evaluation of patients presenting with chest pain. Before, specimens collected in the ED were sent by pneumatic tube to a distant central lab. Moreover, Floyd uses the priority panel feature on the Dimension EXL system to sample the specimen and report the troponin 1st, before other assays are complete.

Thanks to the new lab, “vein to brain-time,” the interval between obtaining a patient’s blood and availability of results to the physician, has decreased by an average of 9 minutes. The fast turnaround ensures that Floyd consistently meets AHA/ACC-guidelines (American Heart Association, American College of Cardiology) for “door to balloon” time. According to the guidelines, interventions such as balloon angioplasty, placing a stent or surgery have to be initiated within 90 minutes after a patient with chest pain enters the emergency department. “Time is muscle, meaning heart muscle”, says Land. “Before we installed the STAT lab in the emergency room, we were taking a big part of those 90 minutes just for lab work”.

Resolving an ED Bottleneck

For a large percentage of individuals presenting to the ED, the initial diagnosis is indeterminate. These “grey

zone”-cases are held for further observation or sent to undergo a cardiac stress test. At Floyd, the workflow from ED to stress testing has been greatly improved recently with the installation of a Siemens Symbia S with IQ SPECT cardiac software. The machine has reduced the average time of stress tests from 27 to 10 minutes. The bottleneck of ED patients requiring stress testing has since been resolved.

The new imaging technology clearly boosts staff morale. Dyrece Evans is the certified nuclear medicine technician running the machine on a recent busy day. “On several days this week, patients were lined up one after the other. Before we would have run into problems. This machine makes all the difference”, she explains happily in a charming Southern accent. She has the numbers at her fingertips: “We are down to six minutes resting, four minutes stress, I love it.” The shorter procedure makes a decisive difference for the high number of elderly and obese patients, who cannot tolerate a longer scan. In some cases the IQ SPECT now provides quality imaging information where it would not have been possible to even attempt imaging before.

Integrating ED-related lab work and imaging technology has been a tremendous asset for the hospital’s

workflow. Now physicians have the tools to confidently identify patients needing intervention within the time frame specified by AHA/ACC guidelines. Compliance with guidelines of professional organizations first and foremost saves lives. In the times of healthcare reform, adherence to best practice guidelines also is vital for a hospital’s bottom line. Under the ACA, the federal government continuously disseminates new directives with the goal of improving quality of care. Non-compliance results in costly financial penalties.

Readmission Rate Decreased by 62 Percent

At the vanguard of the ACA’s efforts to curb growing healthcare spending is a crackdown on costly readmissions. One of the law’s provisions penalizes hospitals, when an excessive number of patients, insured under the federal Medicare program – all Americans 65 years old or older – are readmitted with the same indication within 30 days. With nearly one in five Medicare patients returning to the hospital within a month, about two million people a year, readmissions cost the government more than \$17 billion annually.

Heart attack and heart failure, along with pneumonia, are the conditions, which the federal government presently monitors for excessive rebounds.

“This machine makes all the difference. We are down to 6 minutes resting, 4 minutes stress, I love it.”

Dyrece Evans

Certified Nuclear Medicine Technician,
Floyd Medical Center, Georgia





In the first year of enforcing the provision, Medicare levied penalties against 2,217 hospitals with too many readmissions. Of those hospitals, 307 received the maximum punishment, a 1 percent reduction in Medicare payments for every patient over the following year. The maximum penalty will increase to 3 percent by 2015.

Floyd has repeatedly aced the federal readmission evaluation. In the past years, the hospital's readmission rates for heart attack and heart failure decreased by remarkable 62 percent. "We perform well above the national average", says Land. Integration of lab tests and imaging procedures, ensuring a fast and accurate diagnosis in the ED, contribute to the impressive numbers. Physicians can confidently keep patients with harmless non-cardiac conditions from being admitted. Diligently overseeing the transition of inpatients from hospital to home or another medical facility also keeps rebounds down. At Floyd, nurses call all patients after they have been released, making sure they take their medication and that they receive appropriate follow-up care.

Keeping Patients and Staff Happy

Fast medical attention and short stays in the ED are factors that keep physicians and staff happy. They also drive patient satisfaction. Under the new health law, an unhappy patient translates into increased costs. As a financial incentive to improve treatment, the federal government last year began meting out bonuses and penalties to hospitals based on their quality of care. Quality measurements at this time include the death rate, the number of medical mistakes and infections from catheters. A full 30 percent of the quality score is based on surveys of patient satisfaction, which every hospital has to take.

Floyd seems to know how to keep its patients happy. Every morning the staff spends "huddle time", discussing the important issues of the day and sharing feedback from patients. "It makes my day when we get a glowing review and it encourages me to do even better", says Administrative Laboratory Director Dianne Nichols. Timely quality medical atten-

tion is of course key to patients' positive experience. A warm and welcoming atmosphere also helps. In that respect, the hospital has made some recent changes. Land: "Now staff greets each other in the hallways, we accompany visitors to their destination instead of vaguely giving directions, and everybody does their part to keep our premises neat and free of litter." And this energetic VP practices what she preaches. On a short walk from her office past shrubs and flower beds to the lobby she bends down three times to pick up and dispose of pieces of trash, none of them bigger than a gum wrapper.

Silvia Sanides, has been working for more than 20 years as Washington-based science and medical correspondent for German print media (Focus magazine), radio and TV. A scientist by training (Masters in Biology), she has covered a wide variety of topics in medicine, health and future technologies.

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IQ·SPECT Doubles Throughput at Busy Cardiovascular Hospital in Brazil

In 2011, the nuclear medicine lab at Pró-Cardíaco decided to upgrade to a Symbia T2 SPECT·CT system with IQ·SPECT. Now, the staff is leading the way as a fellowship site for IQ·SPECT. Dr. Cláudio Tinoco Mesquita provided insights into the lab's decision to acquire the system and how they have leveraged the technology to improve their productivity and patient care.

Text: Catherine Eby

Why did Pró-Cardíaco decide to invest in a Symbia T2 scanner?

Tinoco Mesquita: We chose the Symbia™ T2 SPECT·CT system because our mission is to assist in highly complex cases that are referred to our hospital. In addition to nuclear cardiology exams with attenuation correction, we perform white blood cell scintigraphy for the localization of infections, ¹²³I-MIBG whole-body scans to search for pheo-

chromocytomas, ^{99m}Tc-octreotide scans for the evaluation of neuroendocrine tumors, ^{99m}Tc-sestamibi scans for hyperparathyroidism and ictal brain SPECT for epileptical-focused localization, as well as other complex exams that depend on the full potential of nuclear medicine and CT. The quality of the hybrid images we would be able to obtain with a Symbia T2 SPECT·CT with IQ·SPECT was the pivotal factor in our decision to acquire the system.

Why did you upgrade to IQ·SPECT?

Mesquita: We do not have a lot of space in our institution. It was not possible to operate two SPECT systems, and we needed the ability to perform more exams. So, we decided to upgrade to a technology that could increase our productivity without losing image quality.

What IQ·SPECT feature is most important for your practice?

Mesquita: For us, the most important aspect of IQ·SPECT is the very fast acquisition time. We reduced our acquisition time from over 20 minutes (15 minutes supine plus 5 minutes prone) to just 5 minutes (4 minutes for the SPECT plus 1 minute for the low-dose CT). Additionally, our accuracy increased by having attenuation-corrected images.

Did IQ·SPECT help you to improve throughput? How many cardiac examinations are you able to do now versus prior to acquiring IQ·SPECT?

Mesquita: IQ·SPECT greatly improved our throughput – we doubled the number of cardiac scans from 11–12 per day to 22–24 scans per day. In peak periods, we have performed up to 32 scans in a 12-hour working day. Within the first 18 months, we have scanned over 2,000 patients using IQ·SPECT.

How has IQ·SPECT impacted staff scheduling?

Mesquita: Because we have more patients and a shorter acquisition time, our nuclear technologists are very busy all day long.



“The quality of the hybrid images we would be able to obtain with a Symbia T2 SPECT·CT with IQ·SPECT was the pivotal factor in our decision to acquire the system.”

Cláudio Tinoco Mesquita, MD
Pró-Cardíaco Hospital, Rio de Janeiro, Brazil

Pró-Cardíaco Hospital

Pró-Cardíaco Hospital is a 100-bed tertiary cardiovascular hospital in Rio de Janeiro, Brazil, which specializes in unique heart procedures, such as heart transplantation, left-ventricular device implantation and transcatheter aortic valve implantation.

The nuclear medicine lab has been in operation for more than 10 years and includes four nuclear medicine physicians, a medical physicist, a biologist, nuclear medicine technologists, nurses and cardiologists. Additionally, as a teaching hospital, the staff includes nuclear medicine, intensive care medicine and cardiology residents.

In your opinion, what is the clinical value of IQ-SPECT?

Mesquita: The advantages we have realized with IQ-SPECT include reduced acquisition time, 25 percent less dose than our previous scans; and when we scan stress-only images, we can reduce dose by up to 65 percent with better image quality, increased counts and attenuation-corrected images.

Did you need training to use this improved method of acquiring cardiac images? How long did it take for you and your staff to become confident when reading the images?

Mesquita: Naturally, we needed some training. At first, we performed scans both with the LEHR collimator and with the SMARTZOOM collimators to compare images and create our new mental map of cardiac images with IQ-SPECT. After a few exams, we also exchanged experience with a more advanced user, Dr. Bouchard from Canada. After a few weeks, we became confident enough to only use IQ-SPECT and since then we have performed more than 2,000 scans. Our staff has completely adapted to IQ-SPECT, but initially it was important for them to gain experience with the technology as the approach is unique. If you are not familiar with using attenuation-corrected myocardial SPECT, you have to adapt to specific image signatures. This was a fairly easy process though, and now, when we see images performed without IQ-SPECT, we have to adjust how we read the images.

What are the key things to keep in mind when transitioning from other image reconstruction methods, for example, filtered-back projection, to IQ-SPECT imaging?

Mesquita: You have to understand and identify some changes in the IQ-SPECT images that differentiate them from filtered-back projection images. Some physicians call them image signatures. The most common is the apical thinning that is attributed to attenuation correction. Another important image signature is the better homogeneous distribution of the counts compared to previous image reconstruction methods that have increased lateral wall counts. You have to configure these changes to create a new map for reading the exam. Some physicians can do this very quickly, while for others it can take a bit longer.

Can you share examples of the clinical value that IQ-SPECT has brought to your practice?

Mesquita: Because we do a lot of emergency cases, sometimes you have 2 or 3 new patients on the schedule. With a fast system, like Symbia T2 with IQ-SPECT, it helps you keep up with demand and avoid chaos. Another important aspect is the CT images. Sometimes you can find another cause for the patient symptoms by just reviewing these low-dose CT images. We have discovered some lung tumors and pleural effusions that were previously unnoticed.

What does it mean to be a Siemens fellowship site, and why did you decide to have your facility designated as one?

Mesquita: We decided to share our experience with other groups because we believe that it can be very helpful in their transition to IQ-SPECT. As we are a teaching hospital, we are very adept at helping people learn and experience new technologies.

What guidance would you provide to someone who has just upgraded to IQ-SPECT to help ensure a smooth transition?

Mesquita: You must have a goal, for example, to increase the quality and number of exams. Learn how to use the technology. Compare cases. Compare images. Exchange experiences. Create a new mental map of the exam. You have to move yourself from a stationary point to a new point.

If you could summarize IQ-SPECT in one sentence, what would it be?

Mesquita: Fast and good.

Is there anything else you would like to add about your experience with IQ-SPECT?

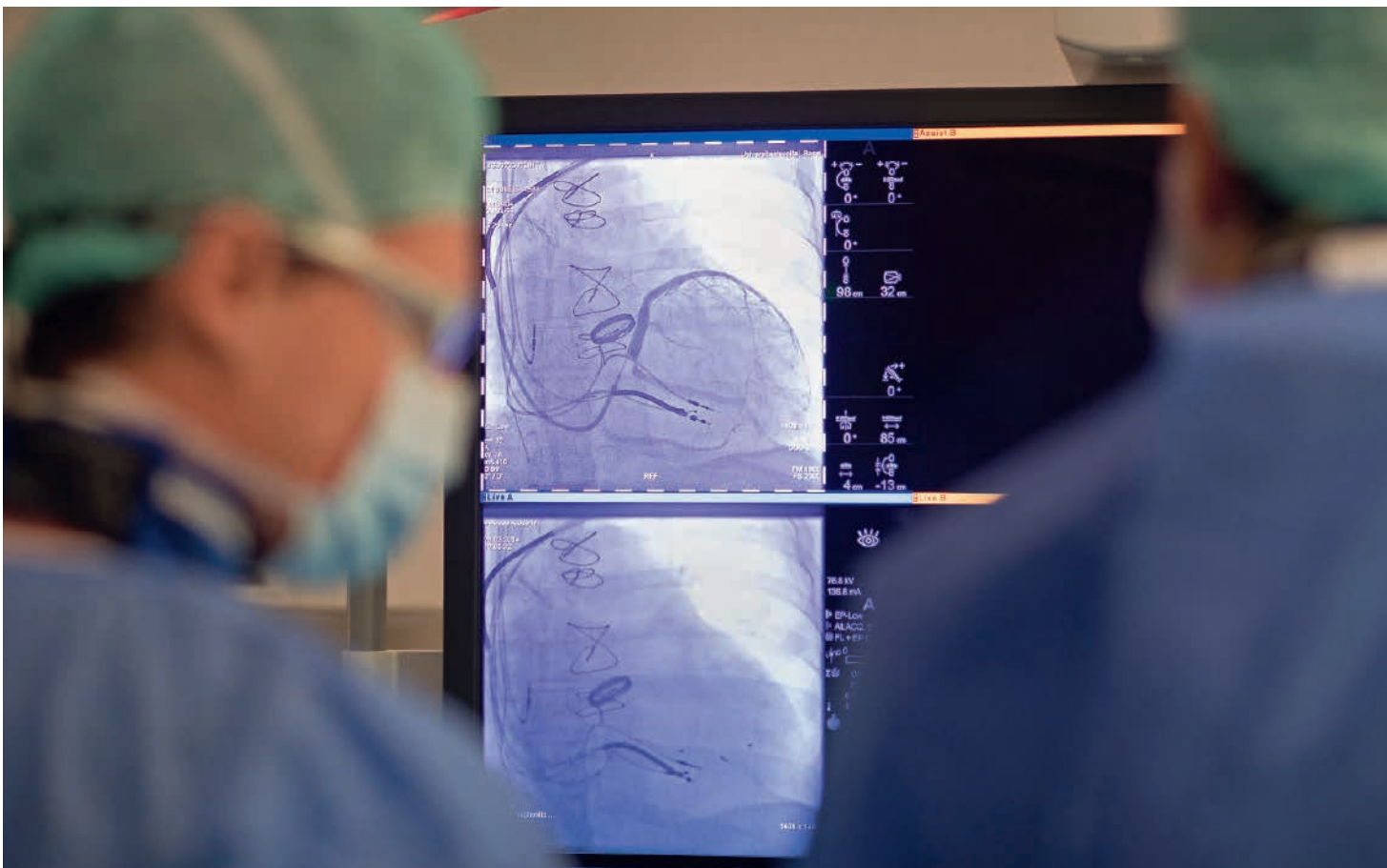
Mesquita: Lead your team. Be the change. Move everyone with you. It is the only way for a smooth transition to a new technology such as IQ-SPECT. If you do that, you will see amazing results.

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“Now I See the Stent at All Times”

As procedures in interventional cardiology become more and more challenging, the need for better image quality rises and radiation dose exposure has become an increasingly important topic. The Siemens Artis Q.zen answers the challenge, achieving high image quality with half the radiation dose of established angiography systems. This was the conclusion of a clinical study at Basel University Hospital, where the first Artis Q.zen system worldwide was installed.

Text: Juliane Lutz | Photos: Uwe Mühlhäuser



New tube, new detector: less exposure and sharper images

Artis Q.zen achieves a reduced radiation dose thanks to the new GIGALIX X-ray tube and a revolutionary new type of detector. To date, the angiography tube is the only one on the market that is fully equipped with flat emitter technology. The new tube enhances image quality in challenging situations such as with obese patients or in steep angulations. The small square focal spots of the GIGALIX result in higher spatial resolution for all clinical applications and help to better visualize small devices and vessels.

The new detector in Artis Q.zen allows imaging at the ultra-low dose range of 6 nGy per pulse. What makes the system unique is that the detector is based on crystalline silicon technology, instead of amorphous silicon technology. Crystalline silicon has a homogeneous chemical structure. It helps to amplify the image signal directly at the detector and significantly reduces the electronic noise in the image. Cardiologists can therefore achieve the same image quality at a lower dose.

Basel University Hospital's Cardiology Department is one of the leading interventional centers in Europe – a fact reflected by the significant number of patients from neighboring Germany, Austria, and countries even farther away. Statistics show that, among other procedures, 2,292 coronary angiographies were performed here in 2013, including 1,130 coronary interventions and 436 ablations. 99 patients received a transcatheter aortic valve implantation (TAVI), additionally 237 pacemakers and 99 implantable cardioverter defibrillators (ICDs) were inserted.

Since cardiac procedures are performed much more frequently today than just a few years ago, and their complexity is increasing, it is becoming ever more important to reduce the radiation dose in the cath lab. This clearly benefits patients as well as medical staff. Typically, interventional cardiologists and electrophysiologists are exposed to scattered radiation for decades throughout their careers. There are indications of an increased incidence of brain tumors among interventional cardiologists, and this is a big driver in the currently ongoing discussions about radiation safety.

In 2012, Israeli and French researchers reported four cases of left-hemispheric brain tumors detected in cardiologists from Haifa and Paris who worked long-term in cardiac catheterization labs.

In March 2014, the Israeli cardiologist Ariel Roguin published a report in the *European Heart Journal* about 35 cardiologists and radiologists who had developed brain or neck tumors. In 26 cases, the tumor was left-sided, which might be explained by the fact that interventionalists generally work on the right side of patients, where they are close to the X-ray tube.¹

"During procedures, we stand next to the source of radiation practically all day long," says Professor Stefan Osswald, MD, Head of Cardiology at Basel University Hospital. "That's why I was immediately ready and willing to try out the Artis Q.zen." In fall 2012 the system was installed in Basel for the first time anywhere in the world. The Artis Q.zen helps to perform electrophysiological and cardiological procedures with an unprecedented reduction in radiation dose – far below the level that is usually required. This improvement is attributable to a change in detector technology. Conventional detectors consist of amorphous silicon, whereas the silicon in the new detector has a crystalline structure, which is more homogeneous. This allows to amplify the electric signal on pixel-level and minimizes electronic noise in the image significantly. Additionally, the Artis Q.zen's X-ray tube is completely equipped with flat emitters that allow for smaller square focal spots. This improves the



The cardiology team at Basel University Hospital found the right solution to their demand for optimal image quality at significantly reduced dose: Artis Q.zen.

system's ability to detect even the smallest structures by up to 70 percent.

A 50 percent lower dose during electrophysiological procedures

No one knows better how well the new Artis Q.zen system performs than Michael Kühne, MD, Head of the Electrophysiology Lab. "We found out that doses are significantly lower compared to previous systems," he explained. In complex cases, like an ICD implantation for cardiac resynchronization therapy, it might take

more than an hour to place all three intracardiac electrodes correctly. "During this time, the patient is exposed to long periods of fluoroscopy, so keeping the dose as low as possible is very beneficial," Kühne says. In the case of a recently implanted CRT-D, for example, he needed 9.3 minutes of fluoroscopy, with a total applied radiation dose of 824 μ Gym.² "The total radiation dose depends, of course, on various factors, such as the patient's body mass index (BMI) and the anatomies of the coronary sinus and great cardiac vein," Kühne explains.

The Artis zee is another member of Siemens' angiography system portfolio, and it is also installed in Basel. The Artis zee is known for its state-of-the-art technology. A level of 40 nGy per pulse is necessary to achieve diagnostic image quality, according to Sven Knecht, MD, research engineer in the Cardiology Department in Basel. With the Artis Q.zen, just 15 nGy per pulse is sufficient.

An effective dose reduction of about 50 percent was documented in a study conducted in the Electrophysiology Lab with 180 patients between March 2013 and March 2014. The

results were presented at the Congress of the European Society of Cardiology (ESC), that took place in Barcelona at the end of August 2014.[2].

Knecht points to another advantage of the new technologies incorporated into the Artis Q.zen: "The larger size of the new detector simplifies the procedure, especially in rotational angiography." Previous smaller detectors were often inadequate for that, he notes. The close collaboration with Siemens is also positive. "The application specialist and the service technician are often with us in the hospital," he says. "And I can call them up at any time." Knecht also values the solid technical expertise of the Siemens employees. The bottom line for him: "The system delivers what has been promised."

New software applications simplify the work with stents and intravascular ultrasound

The Artis Q.zen also finds a strong support in the Interventional Cardiology Department at Basel University Hospital. "I find the combination of reduced radiation and improved image quality very persuasive," says Professor Christoph Kaiser, MD, Head of Interventional Cardiology. "Whether

in TAVI or coronary stent implantations, we benefit from the new system in all procedures." During TAVI, Kaiser says, the optimized image quality lets him visualize the valve more clearly and therefore place it more accurately. For him the new software application CLEARstent Live is particularly helpful. During implantation, CLEARstent Live enhances stent display while compensating for motion at the same time. "Stents are becoming thinner and more difficult to visualize in detail. When we overlap them to cover very long lesions, their placement has to be precise to the millimeter," says Kaiser, describing the particular challenges in his field of expertise. Any gaps between the stents could lead to complications such as embolisms, thrombosis or renewed narrowing. The previous application, CLEARstent, displayed the stent only as a frozen image. Kaiser explains: "You had to continually check where you were. With the help of CLEARstent Live, I now see the stent at all times in excellent detail. That makes life much easier."

Another new software tool for the Artis Q.zen, called IVUSmap, also enhances the work of interventional cardiologists. During treatment of coronary heart disease, the software



"With the help of CLEARstent Live, I now see the stent at all times in excellent detail. That makes life much easier."

Professor Christoph Kaiser, MD
Head of Interventional Cardiology
at Basel University Hospital, Switzerland

helps synchronize angiography images precisely with intravascular ultrasound (IVUS) images. "In the past, you had to continually switch back and forth between views," says Kaiser. "Now I know the accurate location of the IVUS probe which is updated every second. This reduces the need for fluoroscopy, and that means a lower radiation dose. Also, the amount of iodinated contrast agent, which can induce kidney damage, can be reduced."

A guarantee for long-term quality and service

"Something that speaks very clearly in favor of the Artis Q.zen is that it works with lower doses than conventional devices," says Osswald, summarizing his experience. Thanks to the very high resolution of individual images, he notes, the pulse rates can be reduced even more. "And despite that, we still see the very fine PTCA wires when they are moved, for example," Osswald says. In his view, Artis Q.zen rates as one of the world's best angiography X-ray systems.

Speaking as an experienced interventional cardiologist, Osswald thinks there's something else that speaks in favor of the system: "An angiography system has to run for years. For that

reason, a company's service performance is at least as important as the product itself." He says his experience with the Artis zee has been very good, in terms of long-lasting quality as well as service.

For the future, the Head of Cardiology at Basel University Hospital would like to see rotational angiography automatically fused with the EP mapping system, so that they no longer require manual adjustments at the electro-anatomical mapping system.

Juliane Lutz is the business editor of the Swiss newspaper *BERNER ZEITUNG*. Her areas of specialization include the pharmaceutical industry, HR and consumption. In addition, she is a freelance writer for the German daily *Süddeutsche Zeitung*.

¹ <http://eurheartj.oxfordjournals.org/content/35/10/599.full>

² Source: Basel University Hospital

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"In my view, Artis Q.zen rates as one of the world's best angiography X-ray systems."

Professor Stefan Osswald, MD
Head of Cardiology
at Basel University Hospital, Switzerland







Innovations & Research



The Portuguese Pioneers of 4D-Intracardiac Echocardiography

Downsizing interventional teams, increasing patient safety, and saving more lives: real-time 3D intracardiac echocardiography (ICE), also called 4D-ICE, has been used, in a world first, by cardiologist Dr. Vasco da Gama Ribeiro at the Centro Hospitalar Vila Nova de Gaia/Espinho in Portugal to guide interventional closure of a left atrial appendage. For the first time, this ICE technology delivers high-resolution volume images from within the heart – without the need for general anesthesia as it is necessary when using transesophageal echocardiography for procedural guidance.

Text: Patricia Fonseca | Photos: Thomas Steuer





“Today, the image is everything. We analyze cardiac anatomy accurately in 3D and plan interventional procedures in the best possible way.”

Dr. Vasco da Gama Ribeiro

Founder of the Department of Interventional Cardiology Centro Hospitalar Vila Nova de Gaia / Espinho, Portugal

When Dr. Vasco da Gama Ribeiro's team came out of the cath lab one February morning in 2013, they could scarcely contain their enthusiasm. In just 30 minutes they had successfully occluded Atrial Septum Defect (ASD) in a 57-year-old patient, guided by real-time 3D intracardiac echocardiography (ICE): an innovative, world-first procedure with the ACUSON AcuNav™ V ultrasound catheter. Once again, history was being made at the cardiology department of the Centro Hospitalar Vila Nova de Gaia / Espinho (CHVNG/E) in Portugal – one of the leading cardiology centers in Europe when it comes to interventions in structural heart disease.

The professional path of Dr. Vasco da Gama Ribeiro has been marked by a passion for innovation, and he shows no sign of slowing down. His department – which, for example, installed the first fully digital catheterization

laboratory in Portugal – is where many new techniques and technologies are evaluated in collaboration with pharmaceutical companies, medical technology suppliers and universities from all over the world. Transcatheter aortic valve implantation (TAVI), septal ablation in Hypertrophic Obstructive Cardiomyopathy (HOCM), endovascular aortic repair to treat aortic aneurysms and aortic dissections are some of the pioneering interventional procedures Dr. da Gama Ribeiro has already been involved in.

Anatomical information in real time

The ACUSON AcuNav V catheter has been also used to guide LAA closure in high thrombotic risk patients with atrial fibrillation (AFib). This most common cardiac arrhythmia poses a high risk of embolic complications, such as stroke or mesenteric infarction. About 60,000 AFib patients with

this pathology live in the northern region of Portugal (an area with a population of 700,000, served by the CHVNG/E). The thrombus formation typically occurs in the LAA. According to guidelines, oral anticoagulation is recommended, but was not possible in this patient because of the high risk of bleeding.

Over the past several years, a new therapeutic option, the interventional closure of the LAA, has been developed. The procedure has demonstrated good results in various clinical studies. LAA closure is a challenging intervention, which particularly benefits from real-time 3D-image guidance. Typically, LAA closure is performed in the cath lab with additional transesophageal echocardiography (TEE) guidance. Because of the TEE probe, patients need intubation with general anesthesia in order to reduce the risk of aspiration. “Real-time 3D ICE images give us the necessary anatomical information that allows

The Portuguese heart pioneer

Dr. Vasco da Gama Ribeiro was trained at the University of Porto College of Medicine and worked for four years in Rotterdam, The Netherlands. He returned to Portugal in 1983 and founded the Department of Interventional Cardiology at Centro Hospitalar Vila Nova de Gaia/Espinho. He has saved thousands of lives – not in Portugal alone. He performs cardiac interventions at numerous institutions in Europe and the United States at the invitation of other hospitals, and often finds a way to do volunteer work in developing countries.



us to perform the procedure while avoiding the complications of intubation and anesthesia,” explains cardiologist Dr. José Ribeiro, in charge of the echocardiography laboratory at CHVNG/E.

The technique, whose clinical use at CHVNG/E had been published in the European Heart Journal Cardiovascular Imaging, shows not only great potential for ASD closure, but also for other cardiac interventions, such as LAA closure, TAVI, or MitraClip therapy. In cardiac interventions such as closure of the atrial appendage, closure of atrial septal defects, TAVI, or interventional therapy of paravalvular leakage, “we rely on transesophageal echocardiography to guide the intervention. However, TEE requires intubation and general anesthesia, increasing the number of people in the cath lab and periprocedural risk,” explains Dr. Vasco da Gama Ribeiro. “With 3D ICE, in most cases, we get exactly the same information

provided by transesophageal echocardiography, whether for diagnosis or treatment. Recovery time does not differ between ACUSON AcuNav V catheter or TEE, although with TEE, complications related to general anesthesia and intubation may occur and extend the length of stay.”

Benefit to patients

Real-time 3D ICE also shows great promise when it comes to MitraClip therapy, which is an emerging interventional therapy for patients suffering from severe mitral regurgitation (MR) for whom surgical valve reconstruction or surgical valve replacement would be too risky. Patients with severe MR typically suffer from severe dyspnea, which significantly impairs their quality of life. “For those patients who cannot undergo surgical mitral valve therapy, we’re offering percutaneous mitral valve intervention. MitraClip therapy adapts the two

mitral leaflets and reduces the severity of MR significantly. It is not a complete cure, but it offers enormous symptom relief to the patients,” proudly says Dr. Vasco da Gama Ribeiro. “And while using an intervention without general anesthesia is an advantage in all patients, in these severely ill patients, it is even more justified,” adds Dr. José Ribeiro. “Real-time 3D ICE has great potential to guide these challenging procedures.”

The use of new technologies is revolutionizing the way cardiologists work, and this is something that never ceases to amaze Dr. Vasco da Gama Ribeiro, year after year. “Today, the image is everything. We analyze cardiac anatomy accurately in 3D and plan interventional procedures in the best possible way. Without imaging, many things simply could not be done. In congenital heart disease, when we perform TAVI – without imaging, it is not possible to analyze the patient’s

anatomy and decide on the best therapy – from diagnosis, device selection and the most appropriate access route to procedural guidance.”

Fluoroscopy guidance alone would not be enough for this type of intervention, explains Dr. José Ribeiro. “Echocardiography is the method par excellence, and real-time 3D ICE represents fundamental progress. During the intervention we can check for procedural complications, like paravalvular leaks, and see whether we need to position the prosthesis higher or lower. Without advanced imaging, the patient runs many more risks, because the level of uncertainty is much higher.”

3D-images in a second

In the 1980s, when Dr. Vasco da Gama Ribeiro came back to Portugal from the Netherlands, echocardiography was just introducing color Doppler: “Angiography was done film-based.” Dr. José Ribeiro notes that you do not have to go far back in time: “In 2000 we had a complex work station, where

we brought in enormous amounts of data obtained via the transesophageal probe and required enormous effort to process the images. It took three-and-a-half hours of work to reconstruct a three-dimensional valve. And what we got was rudimentary. My surgical colleagues had to have a lot of confidence in me to accept that the anatomic presentation was correct. Today, with the ACUSON AcuNav V catheter, we go into the heart and get 3D-images with just one click of a button, in virtually a second.”

However, the greatest benefit will be noticed by the patients themselves. Dr. Vasco da Gama Ribeiro has just returned from Uganda, where he spent three days doing cardiac interventions on dozens of patients. There, he saw three patients he would not risk taking into the intervention room, wherein he did not have the new technologies that are available at his modern center at Vila Nova de Gaia. “Some interventions I can almost do with my eyes closed, because of my experience, but in hearts with complex pathologies,

you cannot take the risk without seeing the true anatomy. One millimeter the wrong way is all it would take for the patient to die in my hands.” During these three days of volunteer work, he literally worked “in the dark,” using simple fluoroscopy without exactly seeing what he was doing. After his return home, he had even greater appreciation for the additional 3D-“eyes” that shed light onto the heart, helping to keep him perfectly on track.

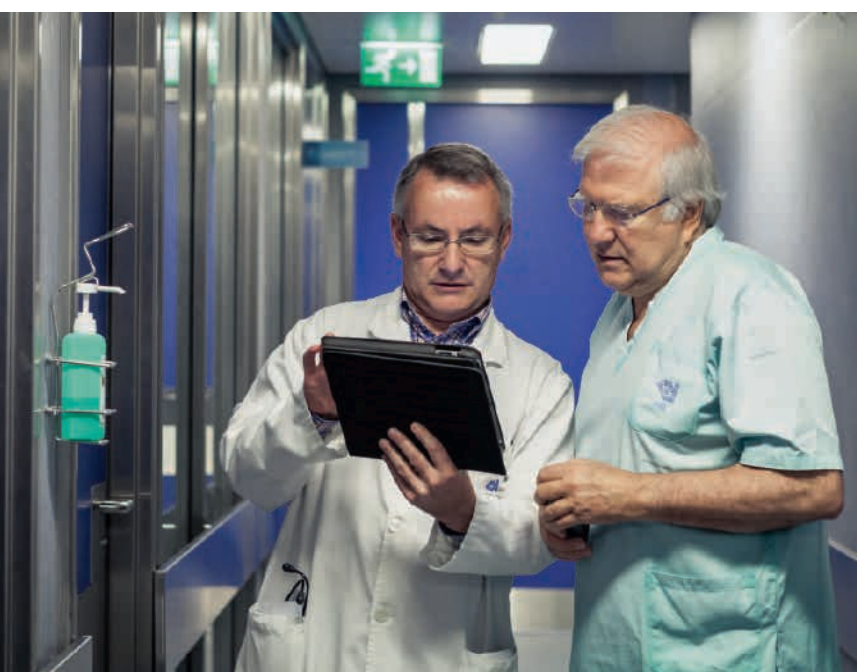
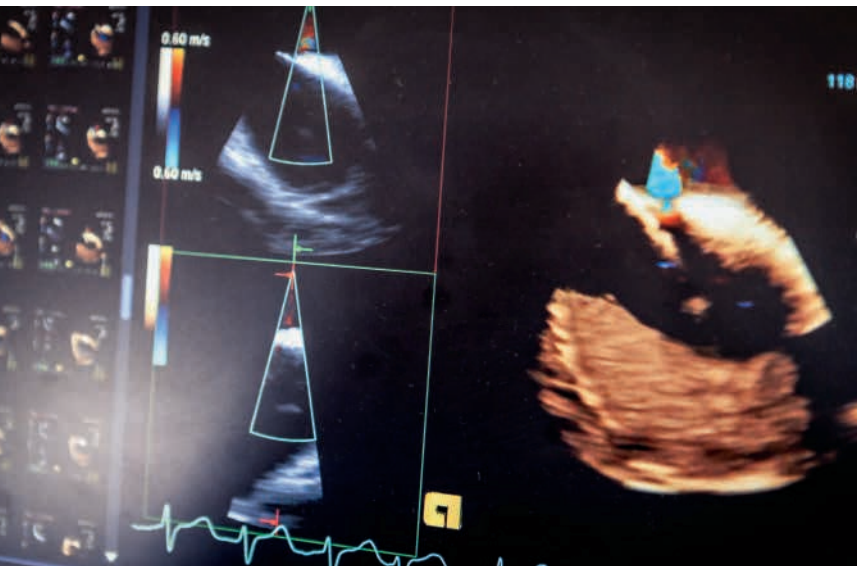
Patricia Fonseca, Senior Writer/Editor, Visão newsmagazine Portugal, since 2003. Studied Journalism at the Washington University/Committee of Concerned Journalists, USA. Awards: EU Health Prize, Finalist (2012), Novartis Oncology Press Prize (2012).

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



“Echocardiography is the method par excellence, and real-time 3D ICE represents fundamental progress.”

Dr. José Ribeiro, Cardiologist
Centro Hospitalar Vila Nova de Gaia / Espinho, Portugal



Getting to the Heart of the Matter:

Evolving Troponin Assays for Earlier Diagnosis of Acute Myocardial Infarction

Text and Graphics: H. Roma Levy, MS



Imagine the following scenario:

- A 45-year-old man arrives in the emergency department (ED) complaining of non-radiating chest pain and dyspnea from which he has suffered for over 6 hours.
- He denies having engaged in strenuous physical activity that might have resulted in injury or muscle pain, and in fact the pain is not exacerbated with deep breathing.
- The patient reports previous treatment for hypertension, but has not continued anti-hypertensive therapy for several years and reports no history of other cardiac or general medical issues.
- A 12-lead ECG indicates no ST elevation, abnormal Q waves, or Left Branch Bundle Block (LBBB).
- Cardiac troponin (cTn) was detectable neither at admission nor 6 hours later according to values obtained using a conventional cTn assay.
- How should the ED physician continue evaluating this person?
- Should more tests be conducted, such as an echocardiogram or stress test?
- Should more invasive testing such as coronary angiography be carried out?
- Should the patient be discharged with the advice to seek outpatient care?

Although radiating pain is considered a hallmark of acute myocardial infarction (AMI), not all individuals exhibit typical symptoms. Therefore, when evaluating chest pain, AMI should not be ruled out on the basis of symptoms alone. Because the majority of patients experiencing AMI have no ECG abnormalities, ECG alone is not sufficient for rule-out in approximately 90% of chest-pain patients arriving in the ED. For these reasons, in accordance with the universal definition of MI first adopted by the European Society of Cardiology (ESC) and the American College of Cardiology (ACC) in 2000, and redefined in 2007 and 2012 by the joint ESC/ACC/AHA/WHF, several criteria need to be considered before AMI can be either diagnosed or ruled out. The current definition is summarized in Figure 1.

The element central to the current algorithm is the observed change of a cardiac biomarker, preferably either cardiac troponin I (cTnI) or T (cTnT). If the cardiac biomarker requirement is not met, none of the other conditions alone or in combination are sufficient to classify or treat the event as an MI. Because its presence in serum or plasma is specific for cardiac myocyte damage and necrosis, cardiac troponin is preferred as a biomarker over CK-MB.

However, cTn assays have evolved considerably over the last decade and differences in detection capabilities have affected how results might be interpreted within the framework of the universal definition/redefinition. Earlier assays (referred to in this article as “conventional assays”) were unable to detect very low levels of cTn with the accuracy achievable by many newer assays, and this typically affected whether or not cTn detection could be ascribed to cardiac injury. The universal definition/redefinition approach originally improved diagnostic accuracy over symptom-only algorithms using conventional assays because – for the most part – such assays detect cTn in no more than 1% of individuals presumed healthy. Thus any patient with at least one cTn measurement above the diagnostic cutoff using a conventional assay has a very high probability of having suffered recent cardiac injury. Although such an injury may be associated with trauma and chronic cardiovascular or kidney disease, in concert with ischemic symptoms, conventional cTn assays are highly specific and sensitive for AMI.

In the past few years, assays have been developed which are more sensitive: they can detect cTn with greater accuracy and at much lower levels, and in most such assays, cTnI may be observed in approximately 50% or more of individuals who are presumed healthy.[2] Assays with varying capabilities of detecting cTn in large segments of the presumed healthy population are referred to in the literature as “sensitive” or “high sensitivity”. In fact, at least one such high-sensitivity cTn assay (hs cTn) has been reported to detect cTnI in 100% of healthy individuals, indicating that Tn normally circulates at low levels that are simply below the

Detection of a rise and/or fall of cardiac biomarker values (preferably cardiac troponin) with at least one value above the 99th-percentile upper reference limit

and with at least one of the following:

- Symptoms of ischemia
- New or presumed new significant ST-segment T-wave (ST-T) changes or new left bundle branch block (LBBB)
- Development of pathological Q waves in ECG
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality
- Identification of an intracoronary thrombus by angiography or autopsy

Figure 1: Key aspects of the 2012 Third Universal Definition of Myocardial Infarction.[1]

analytical sensitivity (i.e., limit of detection [LoD]) of the older assays. [3] This means that it may now be more difficult to determine whether, in the absence of trauma, a positive result actually reflects an ischemia-related rise, whether it is indicative of some other acute or chronic cardiac, renal, or other disease, or whether it is simply normal for that individual.

Needless to say, this has created confusion as to how to interpret sensitive and hs cTn assay results in a clinically relevant way. In which cases should sensitive and hs cTn assay results actually be considered to be of diagnostic relevance for AMI? What criteria should be applied to these tests to rule out AMI? Christian Mueller, MD, FESC, Professor of Medicine and Head of Clinical Research and Acute Cardiac Care at the University Hospital in Basel, Switzerland, addressed these issues in a 2013 webinar which he delivered courtesy of Siemens Healthcare. Before discussing Dr. Mueller’s recommendations on how best to use sensitive and high-sensitivity cTn assays, it is helpful to understand what they measure, how assay precision is defined, and what the difference is between analytical sensitivity (i.e., the detection limit of the assay) and clinical sensitivity (i.e., the cutoff for diagnosing AMI).

Biochemistry and precision

Cardiac troponin assays use antibodies directed at either the I or T subunit of the troponin molecule. The universal definition of MI specifies that cTn assays should be able to detect cTn (either I or T) at ng/L (pg/mL) levels. The coefficient of variation (CV) is an estimate of assay imprecision achieved by measuring multiple replicates of a single sample. According to the universal definition, %CV should be ≤ 10% at the level defining the 99th-percentile in a normal reference population (also referred to as the upper reference limit, or URL). Very few of the earlier-generation cTn assays actually achieved the 10% CV criteria at the URL. In many of these assays, CV at the URL ranged between 20% and >50%, and a 10% CV could only be attained at a level 2 to 3 times greater than the URL. For example, in 2005, five different assays claimed detection of the 99th percentile at 0.1 µg/L (100 ng/L), but the 10% CV (and hence the diagnostic cut point) for these assays ranged from 0.33 to 0.44 µg/L (330 to 440 ng/L). This low precision meant that a value measured at or near the URL might be pathological, but it could just as easily reflect an imprecise measurement of a non-pathological level (false positive). Because measurement was not reliably

accurate within 10% of the measured value until it was 3 to 4 times the URL,[4] and because it can take several hours longer for cTn to reach the trustworthy level than the actual 99th percentile, diagnosis could be delayed, costing the patient valuable treatment time and requiring more ED resources than if a more rapid diagnosis were possible. Additionally, imprecision near the URL can mask small changes in level over time. In this case, the absence of a discernible change over an extended observation period – even 12–24 hours or more into an acute coronary event – might lead to the patient being discharged without appropriate treatment.

What qualifies an assay as “sensitive” or “high-sensitivity”?

In the last decade, many manufacturers have developed new generations of cTn assays with improved analytical sensitivity. Although a classification standard has yet to be fully agreed upon, Dr. Mueller uses analytical precision to differentiate conventional assays from sensitive and hs assays, noting that sensitive and hs assays can detect cTn at the 99th-percentile with imprecision (CV) $\leq 10\%$, whereas as mentioned above, imprecision at the 99th-percentile upper limit of normal (ULN) is $> 10\%$ CV for conventional assays. Thygesen et al., further specifies that hs assays should have an LoD between 0 and 9 ng/L. In comparison, the LoD of most conventional assays detected cTn around 0.04–0.20 $\mu\text{g/L}$ (note that the official units for conventional assays are reported in $\mu\text{g/L}$, whereas hs assays are reported in ng/L or pg/mL).[5] Assays with a lower LoD increase analytical sensitivity by an order of magnitude or more. Many experts in the field (such as the members of the International Federation of Clinical Chemistry [IFCC] task force on cardiac biomarkers) also maintain that assays should only be labeled hs if they can detect cTn in more than 50% of the normal reference population. Many hs assays have been reported to detect cTn in $\geq 95\%$ of presumed healthy individuals, and, as mentioned earlier, at least one has been shown to detect

cTn in 100% of the healthy reference population.[3, 5] In fact, high detection rates in the reference population make calculation of the 99th percentile more precise. This, along with other modifications to assay design, has improved assay precision such that the CV for sensitive and hs cTn assays is $\leq 10\%$ at the true 99th percentile.¹ Thus, in contrast to conventional assays, sensitive and hs assays should indeed meet the requirements outlined in the universal definition consensus statement (Figure 2).

Diagnostic speed and accuracy

Because the analytical sensitivity is so much greater and imprecision at the cut point is considerably improved in hs assays and some sensitive assays, rises in cTn can be seen at much lower levels. This makes little difference in the treatment of the 5% of patients with clear ECG-identified STEMI as they can be diagnosed based on ECG

and symptoms and treated within minutes. However, this increased sensitivity provides a tremendous advantage in diagnosing and treating the much larger population of patients who are experiencing either NSTEMI or unstable angina, and for ruling out AMI in the largest population of patients in whom chest pain is not associated with an ischemic event.

Previously, guidelines for diagnosing NSTEMI using conventional assays required monitoring for cTn elevation above the decision cut point over a period of at least 6 hours, and sometimes for as long as 24 hours. However, in early AMI, cTn concentrations may not be sufficiently elevated to be detectable in the peripheral blood for several hours; in fact, conventional assays are “detection blind” for approximately 4–6 hours after MI onset (Figure 3). Because of this limitation, a patient evaluated in the ED within 2–4 hours of symptom onset might not be diagnosable on the basis of cTn levels upon arrival and would have to remain in the ED with ECG monitoring for several more hours before MI could

¹ The URL and CV for most sensitive and hs assays vary depending on the population, study, and testing site.

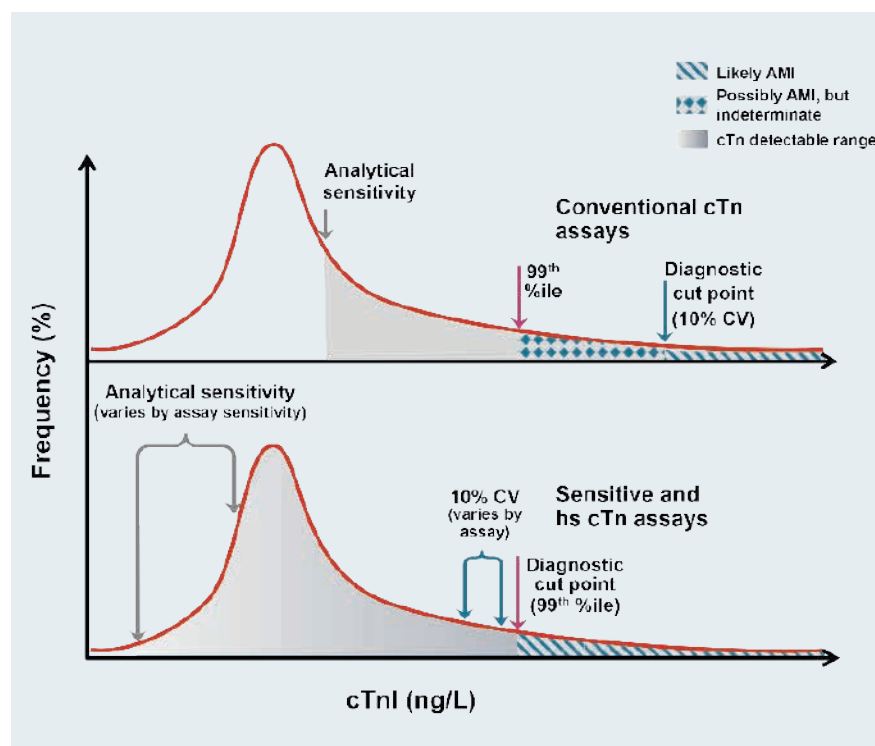


Figure 2: Detection by conventional vs. sensitive and high-sensitivity cTn assays.

be ruled in or ruled out – a situation that contributes to increased resource expenditure, hospital costs, and ED overcrowding. Thus, using conventional assays, unless cTn levels are indisputably elevated at presentation, the shortest time to either rule in or rule out is typically around 7 hours after ED admission (depending on whether or not a second measurement indicates that the cTn level has changed).

Improved rule-in and rule-out of NSTEMI by sensitive and hs cTn assays

In 2011, the ESC recognized that more sensitive assays could begin to detect a change in elevation in blood drawn within 3 hours after symptom onset and recommended that more sensitive cTn assays be used to both rule in and rule out NSTEMI. The ability to detect myocardial damage earlier can be understood by comparing where the decision cut points fall in relation to multiples of the URL for conventional versus sensitive and hs cTn assays (Figure 3). Currently, using a sensitive or hs cTn assay can reduce diagnostic

time to between 3 and 4 hours, and Dr. Mueller and his team project that assay improvements and other considerations (to be discussed below) will eventually lead to a 1-hour diagnostic window. Earlier treatment and reduction of cardiac damage will clearly benefit patients in both the short and long term. At the same time, hospitals benefit by reducing ED congestion, costs, and impact on resources.

In addition to shorter time to diagnosis, diagnostic accuracy of NSTEMI improves with sensitive and hs cTn assay use. With conventional assays, the area between the URL and the 10% CV diagnostic cut point constitutes a gray area or “indecision zone” where levels are likely pathologic but somewhat indeterminate. In his presentation, Dr. Mueller explained that patients with a normal ECG and cTn elevation in this indecision zone would previously have been diagnosed with unstable angina. However, because the CV at the URL is $\leq 10\%$, sensitive and hs cTn assays can reliably detect elevation at their analytical cutoffs,

eliminating the indecision zone. As a result, many of these patients are now correctly diagnosed with NSTEMI and treated accordingly. In general, Dr. Mueller’s team showed that the diagnostic accuracy of a number of sensitive and hs cTn assays is much higher for early diagnosis than conventional assays (Figure 4).[6]

The importance of serial measurements and change

Similar to conventional cTn assays, however, it appears that the greatest strength in sensitive and hs cTn assay use and interpretation lies in serial measurements for both rule-out and rule-in of AMI. Observation of a serial change is especially important for ruling in AMI in cases where cTn may be chronically elevated, such as in patients with structural heart disease, kidney disease, or other conditions in which chronic elevation is common. In 2011 Keller et al. demonstrated that, in combination with using the 99th-percentile as the admission cut point, a relative increase in cTn between admission and 3 hours later

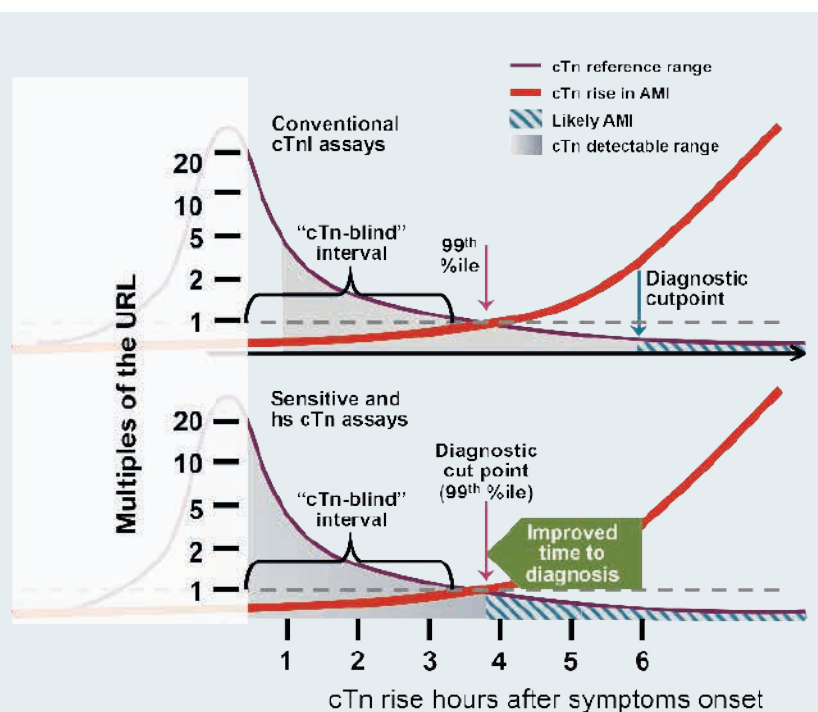


Figure 3: Relation between increasing cTn and the diagnostic cut point.

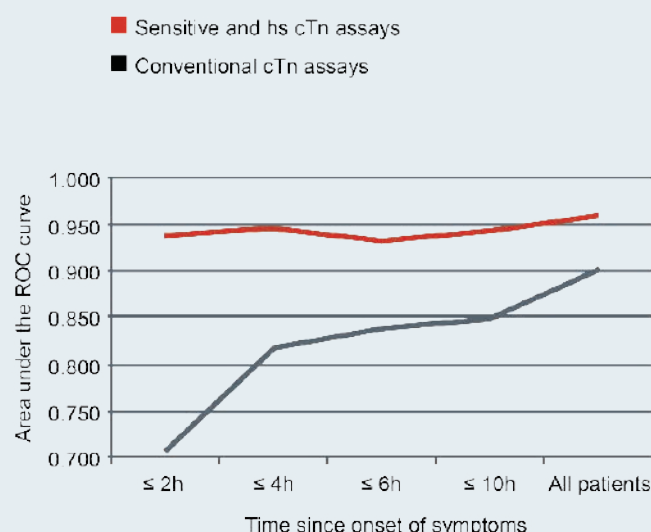


Figure 4: Diagnostic accuracy of conventional vs. sensitive and hs cTn assays.

had a greater diagnostic value than a single elevation at admission.[7] Reichlin et al. made a similar observation for absolute and relative changes at 1 and 2 hours after admission, but also noted that the negative predictive value for ruling out AMI was 98% at 1 hour and 99% at 2 hours after admission if there was no significant change in the cTn level using a sensitive or hs cTnI assay (Negative Predictive Value [NPV] was slightly lower when the relative change was evaluated).[8] Earlier rule-out of non-AMI-associated chest pain, which accounts for ~50% of the ED chest-pain population, would help to substantially reduce ED costs and patient wait times.

These observations and others have led the IFCC to propose guidelines for use of either absolute or relative changes to support rule-in and rule-out of AMI. In this guidance, the IFCC notes that large changes in levels indicate high specificity for AMI at the expense of sensitivity (i.e., some patients with AMI will be missed if the practitioner decides the serial change is too small to justify an AMI diagnosis). Conversely, if a practitioner

prefers to diagnose AMI when the serial change is small for increased sensitivity, specificity will be lower, and more patients might be incorrectly diagnosed with an AMI when the underlying cause of chest pain is not an acute event. Regardless, the serial change value will depend on the assay and timing interval used and will have to be empirically determined. They will still require, however, that at least one measurement is elevated above the URL and that the magnitude of the change observed in a serial reading can be accurately measured according to the CV at the level of change for the assay used. Use of serial changes in cTn levels for diagnosis was the thrust of major discussion at the UK NEQAS Cardiac Markers Dialog meeting held in June 2014.

Quantitative aspects of sensitive and hs cTn assays

Finally, Dr. Mueller's research suggests that positive and negative predictive values may be assignable using specific quantitative results. Very high levels above the 99th percentile are more likely indicative of a large AMI, while lower-magnitude elevations

may be associated with smaller or micro AMIs. More studies are needed, however, to fully develop and substantiate predictive values.

Case study: how using sensitive and hs cTn assays can improve diagnosis

Let us return to the patient presentation at the opening of this article. This hypothetical patient was actually a case study presented by Dr. Mueller. In this case, the man was discharged from the ED with instructions to follow up with his own physician. However, this patient returned to the ED 4 days later with acute chest pain that was more severe and radiated to his left arm and back. A 12-lead ECG was very clearly diagnostic for an acute STEMI, and the patient was immediately revascularized in the cath lab. However, asked Dr. Mueller, might this man have been treated differently 4 days earlier at the initial presentation if a sensitive or hs cTn assay had been used? The answer is likely yes. Dr. Mueller reanalyzed this patient's stored samples using a sensitive cTn assay and two hs cTn assays (Table 1). In this case, unlike the con-

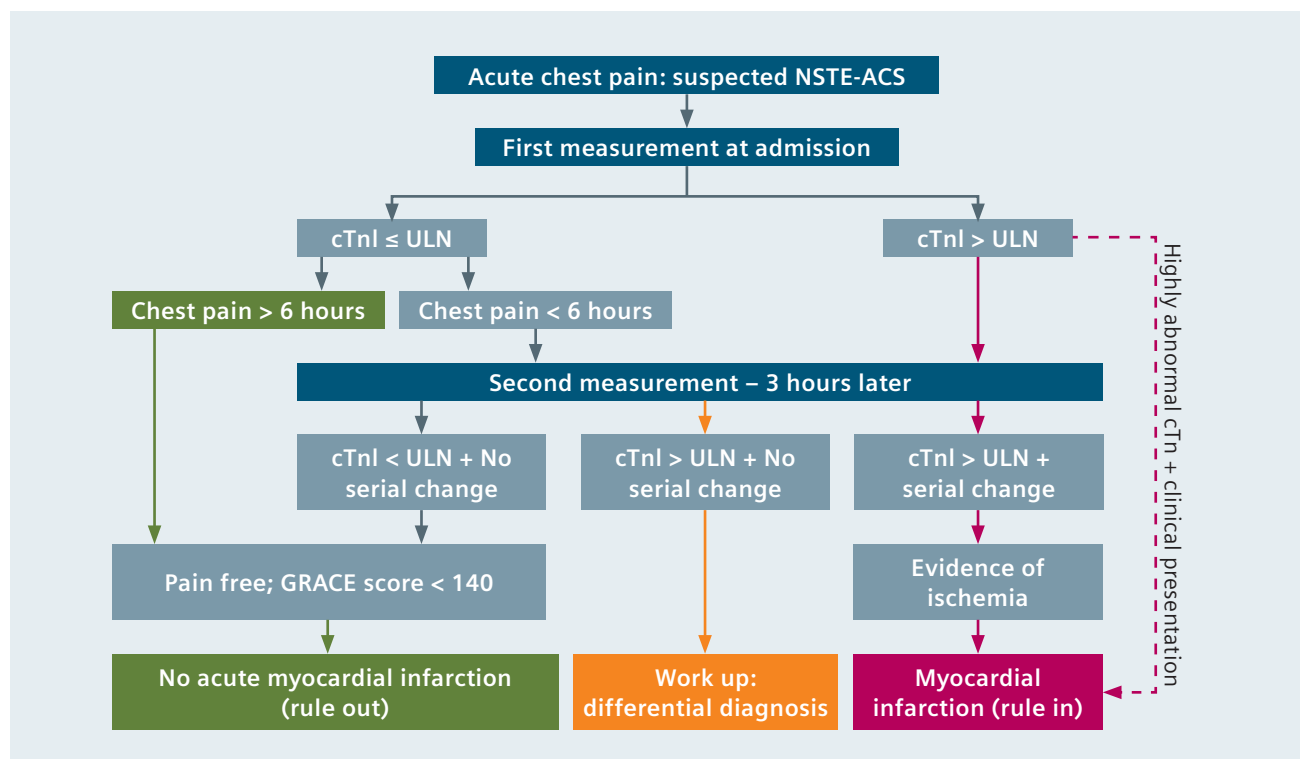


Figure 5: Algorithm for evaluating suspected NSTEMI (adapted from the 2011 ESC guidelines).[10]

Assay	Diagnostic Cutoff	cTn Concentration				
		0 h	1 h	2 h	3 h	6 h
Conventional cTnT (Roche, fourth-generation)	0.35 µg/L	<0.01 µg/L	<0.01 µg/L	<0.01 µg/L	<0.01 µg/L	<0.01 µg/L
Siemens ADVIA Centaur® TnI-Ultra assay	40 ng/L	16 ng/L	39 ng/L	88 ng/L	102 ng/L	
Roche hs cTnT[9]	13.5 ng/L	11.2 ng/L	22.4 ng/L	31.0 ng/L	32.0 ng/L	
hs cTnI in development by Siemens	9 ng/L	18.2 ng/L	44.8 ng/L	66.7 ng/L	100.0 ng/L	

Table 1: Serial measurements of patient samples taken at initial presentation (4 days before STEMI diagnosis) using conventional, sensitive, and hs cTn assays.

ventional assay used at the original presentation, all three sensitive and hs cTn assays detected a serial rise in cTn with at least one measurement above the 99th percent cutoff within 0–2 hours after presentation. In all likelihood, had a more sensitive assay been used at the initial presentation, this patient would have received earlier treatment, resulting in less myocardial damage and scarring, at a lower overall cost of care (considering two ED visits requiring additional monitoring and more resources than a single visit would have required).

Key parameters for using sensitive and hs cTn assays: summing it all up

Clearly, there is much to consider and understand if your hospital laboratory has migrated to a sensitive or hs cTn assay, or is considering doing so. Despite the potential confusion over the interpretation of such assays, Dr. Mueller emphasizes their value for both ruling in and ruling out AMI much more rapidly than conventional assays by summarizing tips for an early diagnosis:

1. Use an assay for which CV is $\leq 10\%$ at or below the 99th-percentile.
2. The 99th-percentile is assay-specific, and either the value supplied by the manufacturer or a value garnered from studies must be used consistently.
3. Quantitative use can increase the predictive value of the test.

4. Absolute changes in serial measurements can help to differentiate chronic from acute cardiac disorders (Figure 5).[10]

Following these recommendations, diagnostic time can be shortened from 6 hours or more to 3–4 hours. As more data is being collected, Dr. Mueller foresees a day when both rule-out and rule-in might be achieved in as little as 1 hour, which would undeniably be a boon to both patients and hospitals.

Clinical implications of a sensitive or hs cTn assay

- Lower levels of troponin can be detected earlier
- Changes in serial samples support AMI diagnosis
- Serial sampling can reflect a change ≤ 3 hours after first presentation
- Earlier detection and serial samples translate to faster diagnosis, improved care, and reduced costs

Further Information

www.siemens.com/healthcare



Dr. Mueller's complete presentation (registration on the site is free and required for viewing)

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A black stethoscope is coiled across a solid red background. The binaural part of the stethoscope is on the left, and the tubing loops around the right side of the page. The text "Reference Sites" is centered in white serif font.

Reference Sites



Team players meeting in the Hybrid OR

Cardiac surgeons and interventional cardiologists are joining their forces in the Hybrid Operating Room in order to achieve the best possible outcome for their patients. The Transcatheter Aortic Valve Implantation (TAVI) program as practiced in the Cheng Hsin General Hospital in Taipei, Taiwan, nicely illustrates this heart team concept. According to Dr. Jeng Wei, head of the Cardiac Surgery Department, and former superintendent of CHGH, TAVI is the best example for a successful interdisciplinary team approach.

Text: Jan Kastner | Photos: Duane Howard

Tucked away in the Taiwanese capital's hilly outskirts district of Beitou, the Cheng Hsin General Hospital (CHGH) operates a heart center that is top-notch not only in East Asia but also by Western standards. Among others on the long list of CHGH's historic achievements are the first total artificial heart implantations in Asia. In the mid-1990s Professor Jeng Wei, MD, MSD, well known for aortic surgery, invented and patented an aortic ring connector which became approved by the FDA in 2006. Since the Heart Center's establishment in 1999, it has been spearheading an interdisciplinary approach by combining conventional

cardiac surgery and endovascular intervention. In CHGH's four state-of-the-art Hybrid operating rooms (ORs), 12 percent of all procedures are performed in a hybrid approach facilitated by advanced cardiovascular imaging and treatment concepts. While Thoracic Endovascular Aortic Repair (TEVAR) and Endovascular Aneurysm Repair (EVAR) have been taking the lead, in July 2013, the CoreValve® certification for proctor-free Transcatheter Aortic Valve Implantation (TAVI) was awarded, fostering CHGH's position in the top league of hospitals bringing forward the interdisciplinary team approach to cardiovascular therapy.

TAVI – in which the heart team approach is no longer just an option but a must – the Heart Center is one among two in Taiwan that has been certified proctor-free for CoreValve®, now aiming to accumulate another 7 to 10 cases to further achieve Edwards Lifesciences' Sapien proctor-free status, according to Associate Professor Wei-Hsian Yin, MD, PhD, head of Cardiology Department at CHGH. The Heart Center started proctor-free CoreValve® procedures on March 27th, 2013, accumulating 32 cases until April this year, the most of any hospital in East Asia, excluding Japan, in the period, Dr. Yin says. The mortality

“A major key to success for the very complex hybrid procedures is intra-operative highend imaging.”

Professor Wei-Hsian Yin, MD, PhD
Head of Cardiology Department,
Cheng Hsin General Hospital (CHGH), Taiwan





rate is 3 percent, which is in line with U.S. and European Union standards.

Complex procedures in the Hybrid OR

"A major key to success for the very complex hybrid procedures is intra-operative high-end imaging," says Dr. Yin. "Just as mandatory are teamwork and the optimization of clinical work flows, as cardiothoracic surgeons, interventional cardiologists, anesthesiologists, echocardiographers, cardiac catheter lab staff, as well as nurses, all play important roles in hybrid procedures." Dr. Yin elaborates that a Hybrid OR is more complex than a conventional operating room, as much more equipment is needed. "Siemens has engineered a convincing solution for the Hybrid OR including integration of a lot of other necessary equipment. We discussed all details with Siemens prior to the

installation, so that the final set-up was meeting all our needs right from the start," he says. "The Artis zeego multi-axis angiography system, the cornerstone in the Hybrid OR, is superbly flexible and quick to adjust. And it delivers highest image quality including tomographic imaging, which helps to perform the procedures at very high quality."

From TEVAR/EVAR to TAVI

The Heart Center pioneered TEVAR and EVAR procedures in Taiwan, bringing to the island interventional procedures that more and more replace the surgical ones. Dr. Yin explains that the Heart Center has recently been applying interventional therapies also for complex valve and aortic diseases. He recalls a case that clearly shows this shift's advantage: "The patient was suffering from significant paravalvular leakage after

surgical mitral valve replacement, and because he had already undergone three surgical valve replacements, an additional open heart surgery would have put the patient at very high risk; but with a transapical interventional approach, guided by the Artis zeego and transesophageal echocardiogram (TEE), we could easily deploy occluders in the leakage."

Dr. Yin stresses that there are abundant examples in the Heart Center's history emphasizing the enormous potential that TAVI is offering especially to very sick patients, who cannot undergo surgery because of comorbidities and the resulting prohibitively high risk. He remembers an elderly female patient with severe aortic valve stenosis, who suffered cardiac arrest. "In the old days, because the patient could not undergo surgery, it would have been next to impossible for her to survive; but with TAVI and thanks to good imaging, we

Taiwan's Cheng Hsin General Hospital – a Siemens International Cardiovascular Reference Center

The Heart Center at Cheng Hsin General Hospital has a long track record of outstanding achievements in cardiology and cardiac surgery. It's one among few Asian heart centers truly pushing the concept of interdisciplinary collaboration. After the Heart Center had turned to Siemens for high-end imaging and innovative therapy concepts for many years, in January 2013

the two partners joined forces establishing the Siemens International Cardiovascular Reference Center.

The center has since earned the CoreValve® certification for proctor-free Transcatheter Aortic Valve Implantation (TAVI), now carrying out more TAVI procedures than many other hospital in the region.

were able to perform TAVI in time after successful resuscitation and hemodynamic stabilization with extracorporeal circulation."

3D: To overcome tricky angles in the heart

Dr. Yin adds that the implanted valve prosthesis worked well, saving the patient's life. Ten days later, the patient's symptoms had significantly improved including shortness of breath, fatigue, dizziness, and chest pain. Dr. Yin furthermore, points out that intraoperative 3D imaging in such interventions is imperative for optimal outcomes. It helps to prevent paravalvular leakage and a displacement of the valve. Pre-procedural assessment of the arterial system is also of greatest importance for a successful TAVI programme, according to Dr. Yin. As unfavourable iliac or aortic anatomy and morphology might pose challenges to the interven-

tionalist, at CGHG CT scans are used for assessment of the vascular status, helping to decide whether to opt for a transarterial or a transapical approach.

Building a heart team

The Heart Center of CHGH is one of the few in Taiwan where the hospital's administrative structure puts cardiac surgery and interventional cardiology together. "The doctors in other Taiwanese heart centers like all over the globe usually are independent departments coming together in the Hybrid OR only case by case. Typically, such a heart center would only allow the interventional cardiologist to become the leading operator, and not the cardiac surgeon, or vice versa," Dr. Yin says. "That means there usually is some conflict between cardiologists and surgeons. We are proud to be a center where the 1st and 2nd operator can either be the surgeon or the inter-

ventional cardiologist, and as we have been set up and working like this from the beginning, there is no such conflict here."

The heart team discusses each case extensively in order to find the best approach for the patient; whether surgery or intervention may be the best suitable therapy, which access route is the preferred one, which prosthesis is the most promising one. Additionally, the Hybrid OR team meets monthly for a comprehensive review of the previous month's cases. The team discusses all cases in detail in order to identify areas for improvement.

The "patient wish" factor is key

"We discuss our strategy with the patients and their families during briefings employing multimedia ani-

mations, and will then follow their wish, if medically reasonable,” Dr. Yin says. “But since Chinese people are by and large more reluctant than Westerners to undergo open heart surgery, if you offer an interventional alternative, more than 70 percent of patients here in Taiwan will agree.” He elaborates that in the case of TAVI, cost is an additional decision point. Unlike hospitalization, medication, operation and aftercare, the aortic valve prosthesis that costs NT\$1 million (US\$33,000) is not covered by Taiwan’s National Health Insurance (NHI), meaning that financial considerations are a major barrier to many Taiwanese patients.

Member of the Heart Team

To work as a cardiologist, cardiac surgeon, cardiovascular nurse, or other medical professional in a heart center that like CHGH pushes the concept of hybrid therapies requires a different skill set. At CHGH, doctors performing procedures such as TAVI must have had over 10 years of experience on valve surgery or have performed more than 1,000 cases of cardiac catheter-

ization because they have to be familiar with interventional techniques, valvular anatomy, as well as specific team response patterns to emergencies.

However, Anne Chen, the Heart Center’s Division Chief of Nursing, notes that for Taiwanese nurses the adjustment is not overly demanding. According to her, this may have to do with nurse training in Taiwan being very standardized, meaning that all nurses in all corners of the island receive comparably comprehensive training from the medical centers and the community hospitals, unlike in some developing countries, where medical training standards in wealthy and poor areas differ vastly. “Coming from a conventional hospital, we only need two or three months of specific hybrid training,” she says. “To me, the hybrid approach has always been natural, with no particular downsides, since I have been working in this heart center compromising of cardiology, surgery, child cardiology, intensive care unit, aftercare, and rehabilitation from the beginning.”

As to what the future will hold for the integration of cardiac surgery and interventional cardiology, Dr. Yin is positive that the trend CHGH has long placed its bets on, will only become more pronounced. According to him, surgery will become more minimally invasive and devices smaller, so that cardiac surgery and interventional cardiology will eventually fully merge. “In the U.S. and the EU some cardiac surgeons already perform cardiac interventions, indicating that in ten years or so, cardiac surgeons and interventionalists may undergo the same training,” he says.

Jens Kastner is a German journalist based in Taipei, Taiwan. His reports on the economy, politics and scientific innovations in Taiwan, Hong Kong and the Philippines are regularly published by various international media outlets.

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

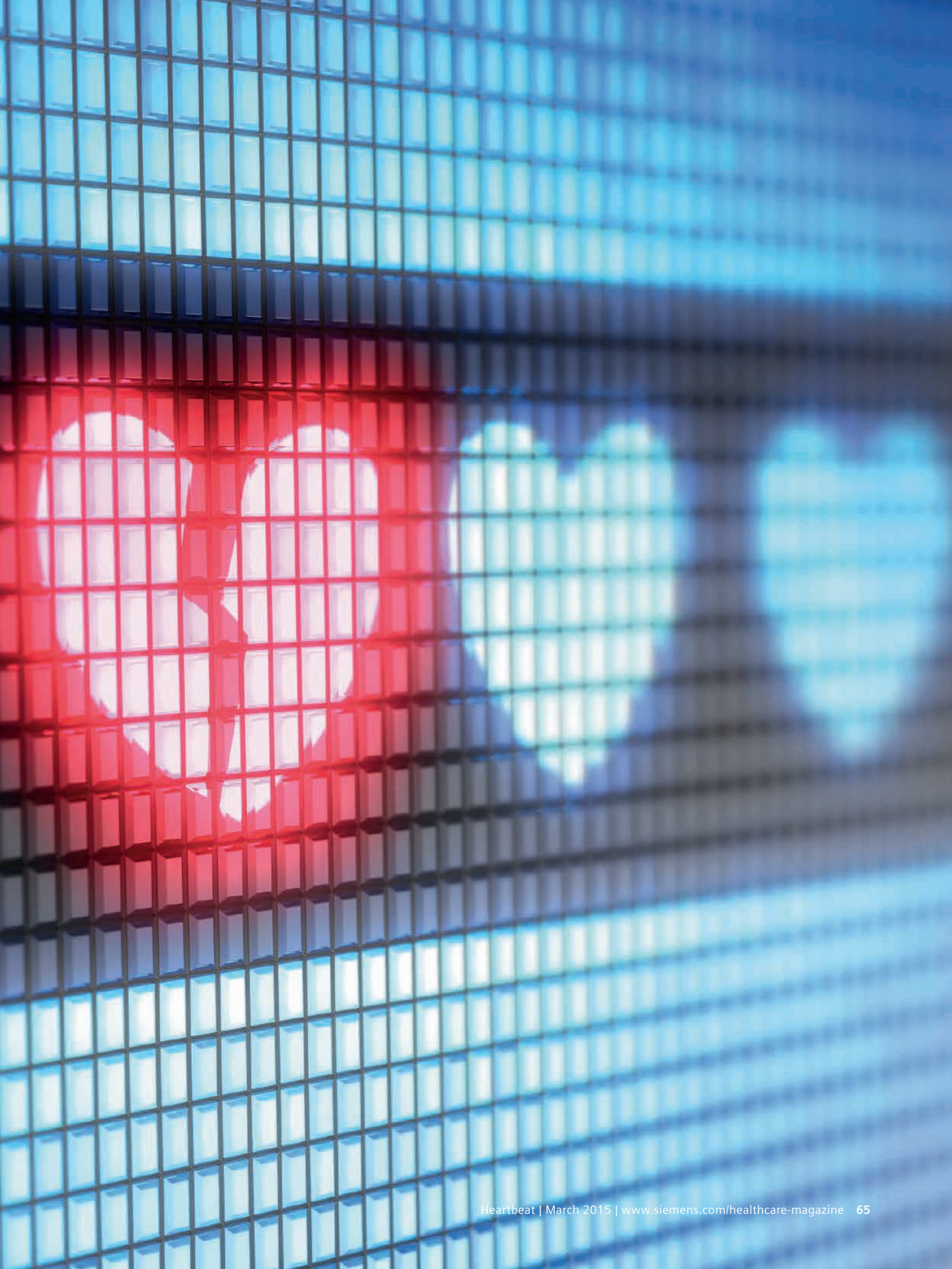
“To me, the hybrid approach has always been natural, with no particular downsides, since I have been working in this heart center compromising cardiology, surgery, child cardiology, intensive care unit, aftercare, and rehabilitation from the beginning.”

Anne Chen, Chief of Nursing
Cheng Hsin General Hospital (CHGH), Taiwan





Management & IT



Technology & Teamwork Take CVIS Up a Notch

This is a tale of making cardiac care better. Better for patients, better for the caregivers providing it, and better for a hospital morphing and migrating to thrive in the new world of accountable care. The tight-knit clinical and IT team at North Kansas City Hospital in Missouri have the key ingredients. Discover their recipe.

Text: Mary C. Tierney



Joe Singleton
Manager, IT Applications

North Kansas City Hospital is a larger hospital among a plethora of healthcare providers in greater Kansas City. With 451-beds and 600 physicians in 49 medical specialties, the facility has one of the busiest emergency departments in Kansas City. This facility, serving a large catchment area north of the Missouri River, is an accredited Chest Pain Center that blends high touch with high tech.

A new strategy for cardiovascular image management sought to improve cardiac care and strengthen the economics at North Kansas City Hospital. The results prove the success with savings in physician and staff time and quicker

hospital discharges. Transcription was replaced by electronic notes and structured reporting, including searchable, quantitative data.

Integrating cardiology

Looking back about 3 years, North Kansas City Hospital had five technology-rich cardiac cath labs and a variety of nuclear medicine systems, echo carts and IT systems to read, create and manage reports. But, they needed a cardiovascular information system (CVIS) that integrated them all, allowed physicians more access points to report efficiently, facilitated greater access to images and reports, and interfaced with their EMR.

A broad search of seven CVIS vendors narrowed down to three. A rigid and comprehensive RFP process helped make the purchase decision, with the final nod to implement Siemens *syngo*® Dynamics coming from both the clinicians and physicians on the selection board. "Previously we had an excessive amount of human intervention to get systems to talk to each other," says Manager, IT Applications Joe Singleton. "That did not work for us; there were too many inefficiencies in getting cases done and reports out quickly. Physician reporting was limited to specific places in the hospital and that needed to be expanded," he notes. "That's why this time we chose a system that would allow us to accomplish our 'dream workflow.'" That dream workflow – for both non-invasive and invasive cardiology – was created by a team of clinicians and IT specialists who took the time to learn each other's languages. The team took to planning from the clinical and IT perspectives – enabling true collaboration to develop among the team in understanding one another's needs and goals, says Cardiac Cath Lab Clinical Nurse Educator Vickie Rupard, RN, BSN, RCIS.

Mapping out a plan

Planning became a three-part process: understanding clinical needs, integrating devices, and creating and refining reporting templates. On the clinical side, Cardiology

Manager Cathy Sullivan was a key liaison communicating clinical needs as were Rupard and Rhonda Taylor, supervisor of the non-invasive cardiology, neurology and vascular lab. Drs. Mitchell and Gimple offered the cardiologist perspective. Stacey Holle, the senior business systems analyst, bridged clinical needs with IT, while hemodynamics/Sensis clinical IT specialist Amy Dewey and clinical IT specialist for CPACS/syngo Dynamics Mike Chastain worked with Singleton on the IT side to make it all work. The IT team translated the patient care processes into the information technology world in terms of all of the interfaces needed between devices and people, and access to data for the physicians. The third piece of the puzzle was the creation of structured reporting templates. The liaisons worked with physicians and one another to refine the templates with all of the needed features and fields for appropriate documentation, viewing, coding, and registry and accreditation reporting, along with physician requirements.

Beginning to end, planning took a year and syngo Dynamics went live in July 2011 with 100 percent physician participation in the non-invasive areas of echocardiography and nuclear medicine. Next were the cath labs, with a new lab coming on-line every 2 weeks. Hemodynamic and electrophysiology integrated recording via Siemens Sensis followed, including bidirectional connectivity with syngo Dynamics.

syngo Dynamics also interfaces with the health system EMR and ADT systems to send demographic data to populate order entry and modality worklists, thus improving patient safety and expediting billing. It also helps in inventory management. Once a physician verifies a report, syngo Dynamics populates results into the Cerner EMR for use by clinicians, and eventually support state-wide health information ex-changes in Kansas and Missouri.

How it works

So what are the benefits of electronic reporting? "We can see this will potentially speed up care for chest pain management, and have a positive impact on length of stay," Mitchell says. "We are seeing greater physician efficiency for sure, in the hospital and in physician's offices, with access to cath lab reports. There is a lot more availability of patient information. In critical care situations, this helps physicians make faster and more informed decisions. Workload balancing between physicians helps with our time management as well." By sharing the number of patient's exams waiting to be read, for instance in echo, patients can be diagnosed, treated, and discharged more efficiently. Tighter inventory management via CVIS is trimming costs, too, and allowing for more informed supply acquisition. Cath lab staff query inventories, and are narrowing the scope of wires and stents ordered to bring down par levels. Electronic data tracking helps the facility track expired materials and order stents for overnight delivery rather than having to stock them. Savings thus far have topped USD 100,000. The cardiology department will soon add a PET/CT system. The new system will be integrated into the CVIS environment for easy viewing and reporting as well.



Cathy Sullivan
Cardiology Manager

Communicating 101

So where were the pain points? In all the change several teammates nod in agreement. The best way to deal with it was conspicuously, being visible and showing value. Mitchell notes, "Reports used to be dictated, then typed, and we had to fill out a diagram by hand. This replaces all of that. It is quick, gets rid of variables in procedures, and doesn't involve a lot of typing, which we as physicians do not usually like." Ultimately, it all comes down to better patient care. "Having a more readily accessible, complete picture of patient data allows us to take better care of patients," Mitchell says. "It has paid off well for our patients, physicians, staff, and overall healthcare efficiency. We are just beginning to see the benefits. Asked if we'd do it again, I would say, 'yes.'"

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

Further Information

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An Image in Time Saves Lives



For doctors and technologists at Saiseikai Utsunomiya Hospital, getting images faster and with more detail was key to improving and maintaining the major hospital's 24-hour patient service quality – especially in the emergency room and within the field of cardiovascular imaging and intervention.

Text: Charles T. Whipple | Photos: Hans Sautter



syngo.via and syngo.plaza not only helps saving Dr. Honda's (right) and his colleague's valuable time, but also improves their ability to provide timely intervention and lifesaving therapies.

Utsunomiya, a city of just over half a million residents, lies 110 kilometers (68 miles) north of Tokyo, on Japan's main island of Honshu. Historically a castle town, the city is now capital of Tochigi Prefecture as well as home to Saiseikai Utsunomiya Hospital (SUH).

SUH first opened in 1972. In addition, it was identified as an emergency center for the entire prefecture in 1981. Today, as the largest hospital in the

prefecture, SUH provides medical care to nearly 1,500 outpatients and more than 600 inpatients per day and is responsible for serving the city and the prefecture with cutting-edge medical technology and therapies.

In 1998, when the hospital moved to a new, larger location in the city, administrators seized the opportunity to equip the hospital with the latest imaging equipment. "Looking back,"

Masanori Honda, MD, the hospital's vice president and diagnostic radiologist and interventionalist, said, "one can see how things have progressed. Take computed tomography [CT] imaging for example: in 1998, we had no multi-slice units; just two single slice ones. It took so long just to get a look at what was going on with a patient. Even later, with 16-slice capabilities, we had to use beta-blockers to get 3D images of the heart, and



While the hospital previously handled around 2,000 CT scans annually, the implementation of *syngo.via* has increased that figure to nearly 2,700.

that meant having a doctor in attendance during the scan." SUH's problem was common throughout Japan's medical community: not enough doctors. Later, the hospital decided to purchase a Siemens SOMATOM Definition. "We were delighted with the SOMATOM Definition," Dr. Honda said. "Because it provided the highest temporal resolution, it gave the sharpest images of any CT unit on the market." After that, SUH purchased two SOMATOM Definition AS systems. Furthermore, the fact that SUH looked for systems that had the highest technological capability based on the most reasonable price brought in a multitude of Siemens systems, such as MAGNETOM® Skyra (3 Tesla magnetic resonance imaging system), MAGNETOM Aera (1.5 Tesla), MAGNETOM Avanto (1.5 Tesla), and the Artis® zeego, and Artis zee biplane angiography systems.

Reliability Earns More Investment

SUH is not solely a specialist hospital. It also plays a key role in acute care for the residents of the prefecture around the clock, every day of the year. This requires appropriate technology so that staff can perform high-quality diagnosis and therapy; surely the goal of any large hospital with emergency room (ER) facilities. "Fortunately, we have the technology here to support us with this," Dr. Honda added. "Because all our modalities are now connected to a single, common platform – Siemens *syngo* imaging IT."

"Speed in diagnostic imaging and emergency medical service is of the essence, as they say. The most important point is how quickly diagnosis can be provided to the patient who

needs effective medical treatment," Dr. Honda said.

"Establishing this kind of environment was the main reason we chose Siemens IT solutions," Dr. Honda said. "Quick and effective diagnostic imaging in acute care requires that adequate images be transferred faster to physicians after image reconstruction and 3D image creation," he continues. "It's not too much to say that *syngo.via*, with its server-based postprocessing within a client-server architecture was developed for acute care. It can easily display the prepared images and thereby automatically process the images that the modalities automatically send," Dr. Honda explained.

The combination of *syngo.plaza* and *syngo.via* enables fast reading of both routine and advanced cases. *syngo.plaza* is Siemens' Picture and Archiving Communications System

Healthcare in Japan

While Japan spends only half as much on healthcare as the United States, Japanese people live significantly longer. Life expectancy for the average Japanese citizen is 83 years.

Japan has a universal insurance system. Around 60 percent of Japanese people are members of corporate insurance systems, with employers paying a large part of their premiums. The remaining 40 percent join municipal or prefectural insurance systems. Everyone is required by law to be part of a healthcare scheme. Only undocumented immigrants fall through the cracks of healthcare provision.

National Health Insurance covers outpatient and inpatient treatments, prescriptions, and most dental care. Eyeglasses, however, are excluded. Local governments administer a further insurance system, which covers long-term care.

Patients under the age of 70 must pay 30 percent of any medical cost, up to a monthly ceiling of around ¥80,000 (around US\$ 860). On anything above this, their liability is limited to 1 percent. Annual medical

costs up to a total of ¥2 million (US\$ 21,500) are tax deductible.

Local clinics are usually the primary healthcare providers. On average, the Japanese make 13.9 physician visits per year (2009), versus 6.2 in Europe and 3.9 in the U.S.

Emergency care can be problematic. Japan has around 30 percent fewer doctors per capita than other OECD countries. This dearth of doctors has caused some hospitals to close emergency facilities or severely limit the emergency care they provide. Doctor may see as many as 100 patients a day without appointments and patients do not have to wait long to be seen. Most clinics are open five-and-a-half or six days a week, and often have radiological and endoscopic facilities.

Despite some weaknesses, Japan's system has much to recommend it. Basic care is affordable and of a high standard. Although the system can take some credit for Japanese longevity, there is also much to be said for the country's healthy eating and exercise habits.

(PACS) that supports high-throughput reading. The tight integration between *syngo.plaza* and the *syngo.via* 3D software for routine and advanced reading helps accelerate workflows across all modalities.

Many Vendors, One Solution

SUH was the first hospital in Japan to install the combination of *syngo.plaza* and *syngo.via*. When SUH decided to update its imaging IT environment, the hospital was using imaging equipment from multiple vendors.

"All our clinical imaging equipment, regardless of vendor, is connected with *syngo.via* and *syngo.plaza*," Dr. Honda said. "But here is the important thing: Until we had established the current, integrated system, it took too much time to diagnose using 3D images."



Saiseikai Utsunomiya Hospital is not solely a specialist hospital. It also plays a key role in acute care.

When asked why, Dr. Honda replied, "Conventionally, processing the 3D images had to be done manually using the 3D workstation. Therefore, it just took too long until postprocessing was completed, especially in the ER. Each second is extremely valuable. To physicians, time truly is of the essence."

Nobody is willing to wait half an hour for a 3D image to appear. Cardiologists, for example, routinely perform measurements based on 3D images in order to place endovascular stent grafts and prepare the appropriate stent. In the ER, needing 30 minutes until a 3D image appears on the screen is deadly for a patient with a ruptured aortic aneurysm. The stent has to be measured and prepared as fast as possible.

"Now *syngo.via*¹ has changed all that," Dr. Honda said. "What used to take 30 minutes now takes 2 or 3 to complete the measurements. So in effect, a cardiologist in acute care consults the radiologist while he is looking at the axial image at the CT workstation. We radiologists tell him the precise results of diagnostic imaging by using *syngo.via*. Actually, as *syngo.via* already shows the appropriately prepared image, radiologists

can immediately start taking and evaluating measurements, such as in pre-procedural planning of stent size. And then, we can discuss treatment based on the detailed evidence."

Dr. Honda pulled up a 3D image that showed a heart, arteries, and veins in a patient's trunk. The heart and blood vessels are color-coded: "Look," he said, and pulled up another image of the same patient's system, post therapy. "This patient now has multiple stents, and is doing well. What's more, the merit of the drug-eluting stent graft is that the patient doesn't need platelet aggregation inhibitors."

Satisfaction at giving patients life-saving therapy is evident in the smile on Dr. Honda's face. "Not long ago," he said, "an ambulance brought in a man with a cardiopulmonary arrest [CPA]. Thanks to our life support, his circulation returned spontaneously. After the CT scan, we realized that this patient had a ruptured abdominal aortic aneurysm. As soon as diagnostic imaging was finished, he was transported into the angiography room with the Artis zeego, and an aortic occlusion balloon catheter was inserted into the descending thoracic aorta. In this case, as this patient was transported

to the angiography room, we had already measured the appropriate stent size with *syngo.via*. We were able to easily select the necessary materials and start the emergency operation. Several days later, this patient was discharged from the hospital without being aware that he had been between life and death."

Doing More With Less

According to Dr. Honda, part of the objective for both *syngo* solutions was to achieve a more efficient and effective workflow. The ultimate way to avoid human error is to automate any procedure. Automatic image processing and analysis with *syngo.via* enables optimal workflow efficiency, and it assumes quite an important role in medical safety. This allows healthcare personnel to focus on their patients and spend less time on image processing, which in turn supports the hospital in its objective to find the appropriate balance between automation and human interaction.

So what does SUH see as the benefits of introducing the *syngo* platform, comprised of *syngo.via* and *syngo.plaza*?

"From the technologists' workflow point of view, *syngo* can help them get



"I am pleased to say that no one had a problem working with the platform."

Masanori Honda, MD
Vice President and Cardiovascular Specialist,
Saiseikai Utsunomiya Hospital, Utsunomiya, Japan

accustomed to the respective examination even if no experts in the specific field are here. From the radiologists' workflow point of view, as the user-interface of *syngo.via* and *syngo.plaza* is newer than that of the current scanner, the look and feel is a little bit different. But as functional tools are similar to those on the scanner, every stakeholder can start using it easily.

"Frankly, it was a matter of concern whether or not diagnostic radiologists could adequately handle *syngo.via* because it was the first server-based postprocessing solution Siemens installed in Japan and it has complex multitudes of clinical applications," Dr. Honda said. "But Siemens stepped in to help, providing greatly appreciated training and follow-up support. I am pleased to say that no one had a problem working with the platform."

And we are certain its capabilities give our patients and us additional health-care benefits: I can list at least three," Dr. Honda said.

1. By combining *syngo.plaza* and *syngo.via*, all stakeholders can work easily with a single platform. This means that they can intuitively operate not only the Siemens scanners, but also the IT system.

2. By linking modalities with *syngo.via*, and sending modality data automatically to the server, images can be seen in virtually real time, already pre-processed and ready for diagnosis. For the ER, this is especially important.
3. With *syngo.plaza*, these images can be easily accessed throughout the entire enterprise with the *syngo.plaza* Web² client, archived, and conveniently called up for follow-up exams.

"We have been quite satisfied with *syngo.via* and *syngo.plaza* so far," said Dr. Honda. "It has enabled a nearly 50 percent increase in the number of patients we see. We are looking forward to new versions with even more capabilities."

Charles T. Whipple is an international award-winning author and journalist based in Japan. His articles have appeared in magazines and newspapers such as *Time*, *Newsweek*, the *Chicago Tribune*, and the *International Herald Tribune*. He has lived in Japan since 1977 and is fluent in Japanese.

¹ *syngo.via* can be used as a standalone device or together with a variety of *syngo.via*-based software options, which are medical devices in their own right.

² Diagnostic reading of images with a web browser requires a medical grade monitor. The statements by Siemens' customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other

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

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Their experience with Siemens led the hospital to purchase further biplane angio and cardiac systems and a system for vascular work.

How I do it





CMR at the Center of Cardiac Care: Case Example Service Delivery at Barts Heart Centre – Advanced Imaging Department

By James C. Moon; Charlotte Manisty; Anna S. Herrey; Steffen Petersen; Mark Westwood

Institute of Cardiovascular Science, University College London;
The Inherited Cardiovascular Diseases Unit and Cardiac Imaging Department, The Barts Heart Centre, London, UK

Introduction: The Barts Heart Centre

Cardiac services for a catchment area approaching 1/3 of greater London, specifically, North Central London, North East London and West Essex, are being reconfigured with a new state-of-the-art cardiovascular hospital – the Barts Heart Centre (BHC). Work will begin with the merger of cardiac services from St Bartholomew's Hospital, The London Chest Hospital and The Heart Hospital to be centralised at Barts site from Spring 2015, whilst construction work to complete BHC is carried out.

The Barts Heart Centre will be fully open from Autumn 2016 with a large scale operation – 232 cardiac inpatient beds, 10 catheter labs (incl. 1x hybrid), 8 cardiac theatres, 40 outpatient rooms with three additional hospitals within Barts Health NHS Trust and other secondary care hospitals outside the Trust all feeding into BHC, serving a catchment area of around 5 million. In addition the service will provide supraregional services including congenital heart disease and national services for cardiomyopathy.

We believe that imaging has an important role to play in the cardiac

pathways putting imaging at the heart of this exciting initiative. Here we describe the UK position of CMR, the proposed structure and format of the new imaging department and the role of cardiovascular magnetic resonance (CMR) within it.

CMR in the UK

CMR in the UK is growing fast. There are more than 60 centres performing CMR. Growth has over the last 5–10 years been consistent at 10–15 per cent a year. Some of this has been new imaging, but much has been disinvestment in other modalities (e.g. nuclear imaging for ischemia). CMR is seen as essential for many well known areas – congenital heart disease, cardiomyopathies, many systemic rarer disease, and acute situations (e.g. troponin elevation with non-obstructive coronary arteries or post cardiac arrest); but it is also a preferred field for many practitioners. In the UK National Health Service CMR is not reimbursed according to a 'fee per procedure' structure, which enables national services to be managed and coordinated to maximize care quality. This means that the traditional 'turf war' between radiology and cardiology is generally more benign than in other environments. There are some training issues however – too many

cardiology trainees want to learn CMR, whereas too few radiologists do.

The imaging context at the Barts Heart Centre

The scale of the new unit is large. Anticipated activity per annum on site is 20,000 echocardiograms (plus 8,000 in satellite hospitals), 9,000 CMR scans, 3,500 cardiac CT scans and 500 nuclear scans (plus 500 in satellite hospitals). Advanced cardiac imaging will operate a network of 8 dedicated cardiac MRI scanners with 3 dedicated cardiac MRI scanners on site, and a further 5 operational in allied hospitals/ services within a year (one additional research/private scanner planned, 2 dedicated cardiac scanners at Great Ormond Street, one new cardiac scanner at Royal Free Hospital and the existing scanner at The Heart Hospital continuing until 2018. Strategically the aim is that cardiac MRI functions within a multi-modality framework where the individual modalities work hand in hand – not just to share the clinical burden, but to ensure that patients are investigated using the optimal technique to answer the clinical question cost-effectively, and to facilitate training and research opportunities. There will be a coherent operational model where the governance system

is common across imaging, there will be common reporting rooms (echo, MRI and CT) – with distinctions being made between ‘quiet’ and ‘teaching’ reporting areas rather than modalities.

CMR subspecialization: New workflows

The main CMR department will have two 1.5T MAGNETOM Aera scanners and a 3T MAGNETOM Prisma. We chose Siemens because of the proven technical quality of their equipment, strong existing research relationships and their trajectory of investment and innovation in CMR. The first Aera and Prisma are currently operational. With 9,000 patients a year anticipated, we are aiming for CMR subspecialization: The 3T Prisma is anticipated to become almost exclusively a dedicated adenosine perfusion CMR platform, capitalizing on the high homogeneity and very high performance gradients. We aspire that perfusion scanning will be sufficiently robust on this magnet that the rest scan can be dropped, improving patient tolerability and workflow (we aim for two patients an hour instead of the standard 45 minute slots).

However, the narrow bore is not for all – the two MAGNETOM Aera scanners with 70 cm bores will take the larger or claustrophobic patients. Here there will also be further specialization – one of these magnets is going to be technician led as is standard, but the other will be mainly doctor run – our research fellows (currently > 10) are all trained to run the CMR scanners and, at the Heart Hospital pass through 4 grades (observer, junior fellow, senior fellow, and level 3 supervisor – who are capable of running clinical lists at weekends without on-site consultant cover). This training is invaluable and generates a cohort of medics with PhDs capable of really leading and innovating in CMR. For reporting we have switched to a 3rd party server based viewing and reporting solution with 25 floating licences. We will also be increasing the number of patients with implantable cardiac devices *in situ* that we scan – many local hospitals are unwilling to scan patients with even MR conditional devices¹ and we have therefore found ourselves providing a regional service for this area.



The new hospital sits behind the existing façade of the Barts square top (this is a computer generated imagery from the architects) – a blend of the old and new.



The first 2 magnets – a Siemens 1.5T MAGNETOM Aera (a – after a hard day's work) and 3T MAGNETOM Prisma (b) are up and running with the third arriving in around 6 months.



The atrium, which is hard to capture on just one view, serves as a focal point for the hospital.

CMR research

Although there is a major service provision aspect, the BHC will have CMR clinical and research activity integrated. To this end, the Barts Cardiovascular Registry was set up to approach all our patients to consent for clinical and image data use and

sharing for research, audit and service improvement purposes with consent for the acquisition of additional sequences that may not yet be part of clinical service provision. Major research interests span the entire translational pathway: From rapid imaging and new sequence design to establish new imaging biomarkers to using

imaging surrogate endpoints in clinical trials to better diagnosing, prognosticating and monitoring treatment in cardiomyopathy, heart failure and coronary artery disease to cost-effectiveness analyses of imaging strategies.

One particular focus is in the use of T1 mapping to identify abnormal myocardium. Major new insights have been gained in rare diseases – amyloid, Fabrys and myocardial iron overload, and rapid progress is being made in diffuse fibrosis in the more common diseases such as aortic stenosis and hypertrophic cardiomyopathy. These developments and a community approach (in part coordinated by the 'T1 mapping development group' led to an international consensus statement on T1 mapping and very rapid technical improvements leading to a commercial sequence 'MyoMaps' containing a suite of mapping sequences.

The magnets are available for use for researchers out of hours at cost – to maximize flexibility and value-for-money from precious research funds. We also work closely with academic physics and engineering groups to maximize the potential of the scanners, and are acting as a Corelab facility for multicenter trials. Our research has been successful over the last few years – more than 15 young investigator awards or shortlists at international meetings have been achieved by the fellows over the last five years in the now merging units. The 2015 SCMR meeting in Nice emphasises this synergy – three fellows are shortlisted for investigator awards, each with a different supervisor, all now coming together under one roof in one institution – a great platform to grow from.

CMR teaching

Course fellows are an integral part of the unit. We limit the numbers to approximately 2 per MR scanner and typically for 3 months so there is involvement – helping with 'first reads' and providing a fresh perspective. Any fees paid are cycled into the research program – particularly for funding fellow travel, education, small equipment items and bridging costs. Several more didactic courses exist e.g. a biannual stress perfusion course, and the course

portfolio is expected to expand to multimodality. We also host the London CMR meeting, a quarterly meeting of approximately 80 CMR specialists who meet to share clinical and research ideas and information. We have been leading the European CMR certification and exam boards for the last few years.

First impressions

The Cardiac Imaging unit has been open since 15 September 2014 with the other units due to decrease activity in Spring 2015, which means the service is currently working across multiple sites, increasing the capacity to remove waiting lists. Weekly staffing meetings are helping to define the culture and operating procedures, a process approached with the good will that is needed when the methods and cultures of three sites have to merge. We have not even started to touch the potential of the scanners – certainly much of our basics are being rewritten with new standards e.g. two cine slices per breath-hold typical, motion correction (MOCO), PSIR for LGE always with T1 mapping on the majority and a future of new approaches such as potentially ceasing to breath-hold for the majority.

A visitor to the unit, Peter Kellman, MR physicist from NIH sums it up: “To see a new facility, a brand new hospital with CMR at the centre of cardiac care is very exciting. There is nothing niche about this high throughput environment. As a researcher in CMR, I feel proud of the efforts of the CMR community – their commitment, talent and resources is putting CMR to the forefront for decision making.”

We endorse Peter's views. The future potential of the unit is hard to scope in detail – we look forward to delivering excellent care and the research aspects that go hand-in-hand – exploiting the gradient performance of Prisma, a closer relationship with the Industry to transition academic ideas and innovations into clinical practice and commercial products; and the use of new CMR endpoints for drug development and the at-scale use of CMR in bio-banking studies, such as UK Biobank. Certainly, the future potential of the unit as a trail-blazing unit is massive.



The reception of the unit will benefit from a new stained glass window being created and gifted by the artist Erica Rollings and her husband Robert Rollings, a CMR practitioner from Savannah, GA, USA. This is a coronal view example of her work.

¹ MR imaging of patients with metallic implants brings specific risks. However, certain implants are approved by the governing regulatory bodies to be MR conditionally safe. For such implants, the previously mentioned warning may not be applicable. Please contact the implant manufacturer for the specific conditional information. The conditions for MR safety are the responsibility of the implant manufacturer, not of Siemens.

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

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Stent Placement Supported by IVUSmap

Courtesy of Jiro Ando, MD

Department of Cardiovascular Medicine, The University of Tokyo, Japan

Patient History

An 80-year-old male, who suffered from anterior chest pain on exertion in February, 2012, was treated via implantation of a drug eluting stent in the left main trunk and the proximal part of the left anterior descending artery.

Diagnosis

Follow-up angiography showed 75 percent stenosis of the distal right coronary artery 8 months after initial treatment.

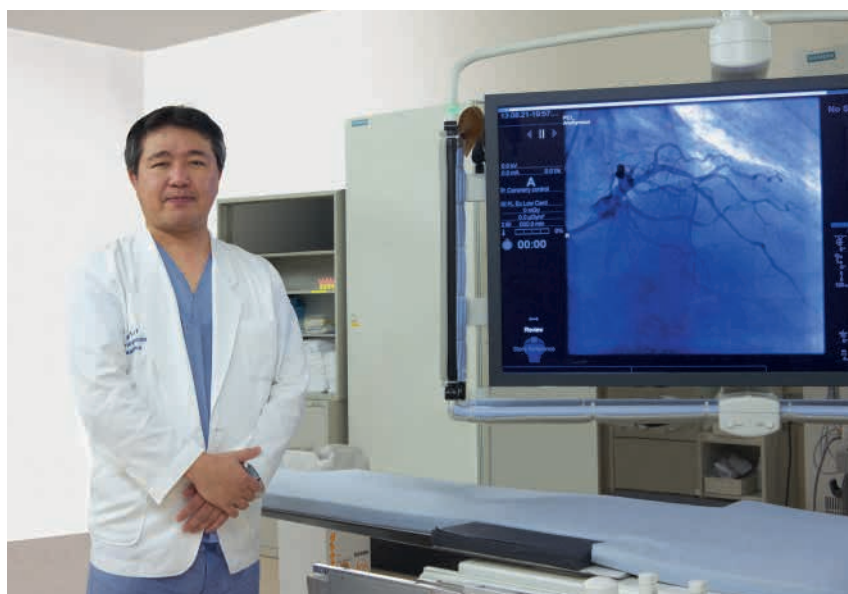
Treatment

IVUS catheter (EagleEye® Platinum, Volcano Corp., U.S.A.) was introduced into the distal part of the RCA lesion, and catheter pullback was performed with an automatic pullback device at a rate of 0.5 mm/sec. ECG-triggered

fluoroscopy was acquired during pullback and was used to perform co-registration of the angiographic and IVUS images. The IVUS image showed a 11.0 mm stenotic lesion proximal to a branch of the distal RCA (white arrow in Fig. 1). The distal end of the stenosis was 10.0 mm away from the branch. The stent end target landing positions were identified at locations where the amount of plaque was comparatively small. The reference diameters were around 3.1 mm, so a 3.0 mm x 14 mm stent (Nobori®, Terumo Corp., Japan) was selected for treatment. The distal RCA branch was used as a reference landmark point during stent deployment. The stent was placed and subsequent angiography showed that stenosis was resolved.

Comments

Stent placement without the use of IVUSmap requires the physician to switch attention between angiographic images and IVUS images alternately, and to orient within the coronary tree, identify branches and radiopaque markers. Highly developed skills and experience of the physician are required to perform these complex tasks. On the other hand, through IVUSmap, co-registered images useful for guidance can be easily obtained by placing two bookmarks on the distal and proximal ends of the stenosis (Fig. 3). IVUSmap provides an easy approach for length measurements between bookmarks visible on either IVUS or angiography images. Our assessment of the co-registration accuracy suggests that this technology can be used for guidance during stenting. I believe that this technology has the potential to contribute to placing stents more intuitively and accurately.

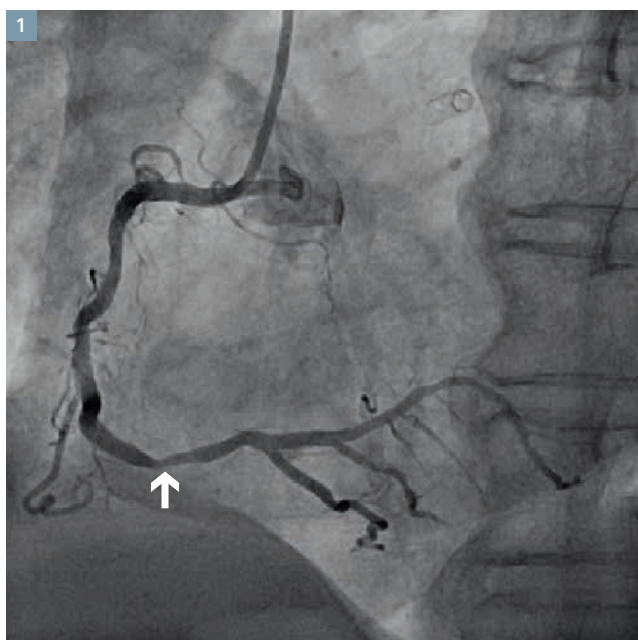


Jiro Ando, MD, in front of his system for cardiovascular treatment.

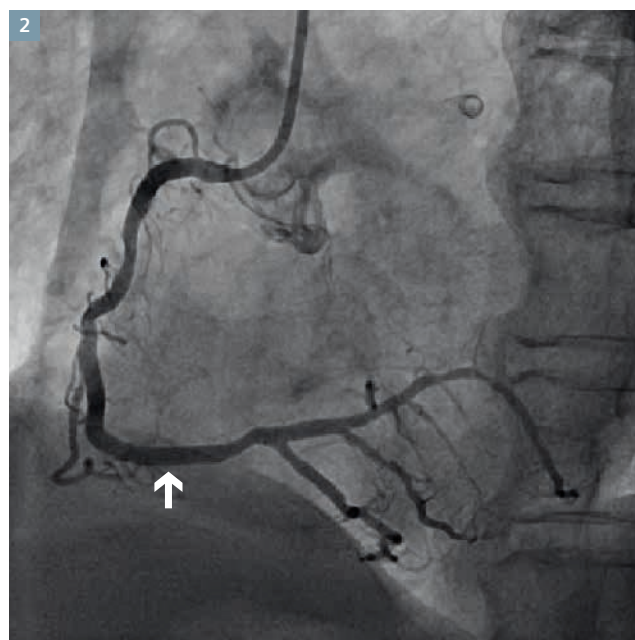
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Contact

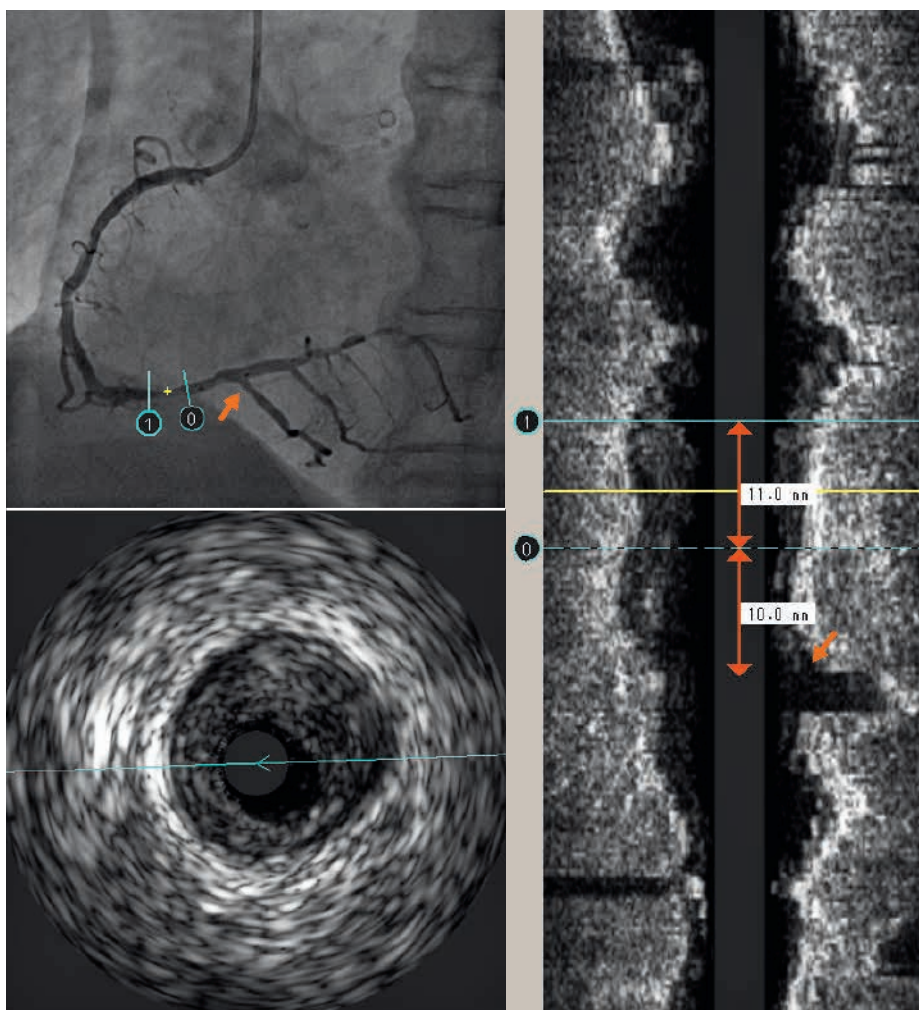
ken.shigeta@siemens.com



1 Angiography before the stenting, which shows stenosis of the distal right coronary artery (arrow).



2 Angiography after the stenting, which shows that stenosis was resolved (arrow).



3 Angiography and IVUS images co-registered by IVUSmap. Two bookmarks are placed on the distal and proximal ends of the stenosis. The orange arrows indicate the branch that is visible in both angiography and IVUS images.

Diagnosis of Coronary-Ventricular Fistula with Giant Coronary Aneurysm using Flash Mode

By Kai Sun, MD;* Ruijuan Han, MD;* Lijun Ma, MD;* Ligang Li, MD;** Gang Wang, MD;* Hailiang Jia; MD*

* Department of Radiology, Baotou Central Hospital, Inner Mongolia, P. R. China

** Healthcare Sector, Siemens Ltd. China, Shanghai, P. R. China

Patient History

A 44-year-old female patient presented herself to the hospital with paroxysmal chest distress after exertion for the past 10 days. The duration of the distress varied between 10 minutes and several hours. There was no history of hypertension or diabetes. An electrocardiogram showed a sinus rhythm without significant ST-T changes. A coronary CTA was requested for further evaluation.

Diagnosis

A coronary CT Angiography (cCTA) using Flash mode with a high pitch and an ECG-triggered spiral scanning revealed an extremely rare combination of coronary anomalies. These included a giant coronary aneurysm originating off a fistula connecting the left coronary artery and the right ventricle, an anomalous single coronary artery arising from the left sinus of Valsalva, and the absence of the right coronary artery (RCA) as well as of the left circumflex coronary artery (LCx).

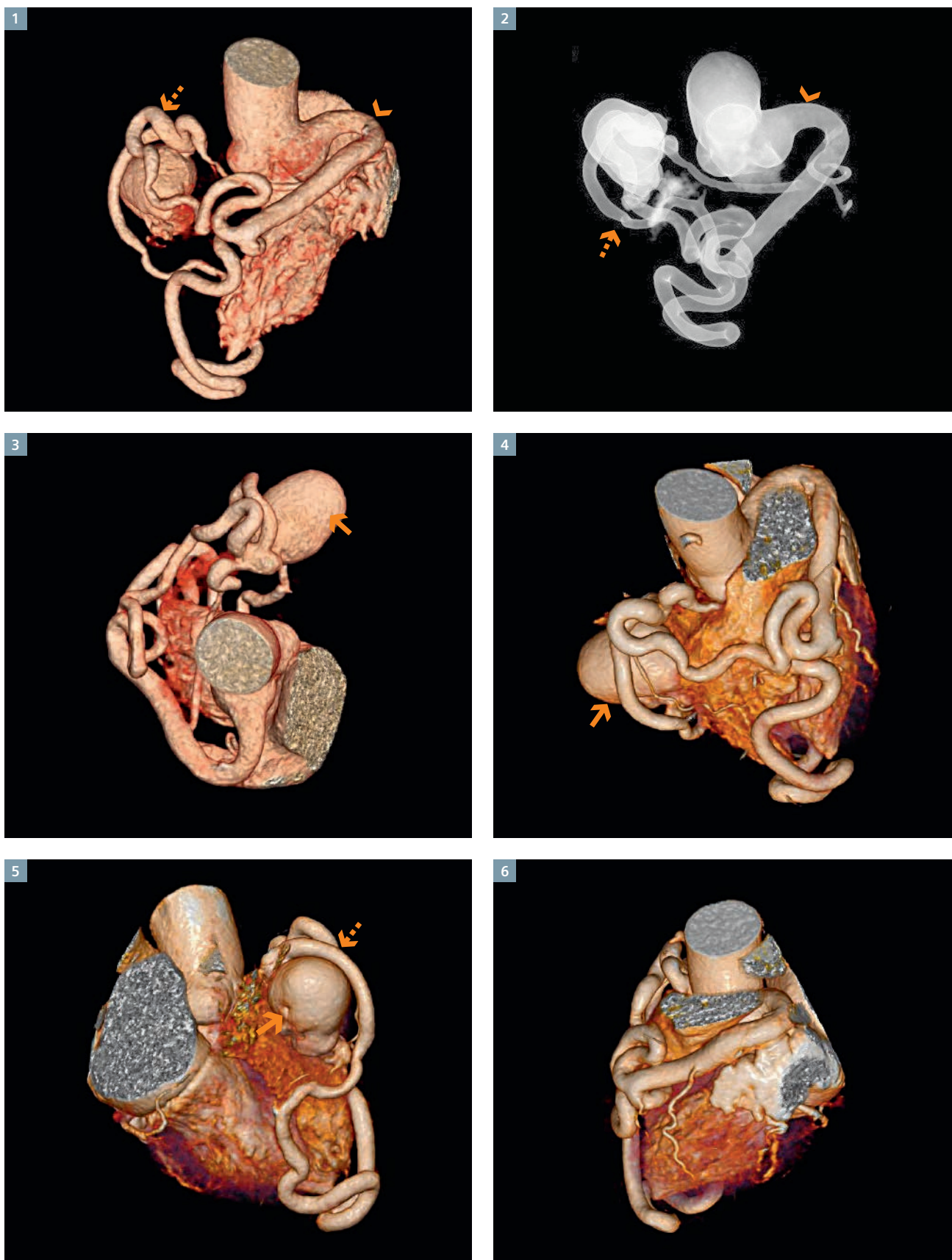
Comments

The combination of such coronary anomalies is extremely rare. cCTA imaging provided a comprehensive overview of the anomalies, thus offering information necessary to aid the physician in diagnosis. Dual Source CT with Flash mode and ECG-triggering, using single spiral scanning and a very high pitch, not only shortens the acquisition time but also reduces the radiation exposure to the patient. In this case, the entire heart was scanned in just 0.23 s with a dose of only 0.8 mSv.

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

Examination Protocol

Scanner	SOMATOM Definition Flash		
Scan area	Heart	Rotation time	0.28 s
Scan length	13 cm	Pitch	3.4
Scan direction	Cranio-caudal	Slice collimation	128 x 0.6 mm
Scan time	0.23 s	Slice width	0.75 mm
Tube voltage	100 kV	Reconstruction increment	0.4 mm
Tube current	375 ref. mAs	Reconstruction kernel	B26f
Dose modulation	CARE Dose4D	Contrast	
CTDI _{vol}	3.59 mGy	Volume	60 mL
DLP	59 mGy cm	Flow rate	5 mL/s
Effective Dose	0.8 mSv	Start delay	8 s



1–6 Images show a giant coronary aneurysm (Figs. 3–5, solid arrows) originating off a fistula (Figs. 1, 2, 5, dashed arrows) connecting the left coronary artery and the right ventricle, and an anomalous single coronary artery arising from the left sinus of Valsalva (Figs. 1–2, arrowheads). The right coronary artery (RCA) and the left circumflex coronary artery (LCx) are absent.

Myocardial Ischemia Assessment using Adenosine-Stress Dynamic Myocardial CT Perfusion

By Dikranian T. *, MD; Ghijselings L. **, MD; Vargas Lobos M. **, MT; Genard L. **, MT; Derauw O. **, MT; Deconinck D. **, MT

* Internal Medicine Department-Cardiology, Europa Clinics, Brussels, Belgium

** Medical Imaging Department, Europa Clinics, Brussels, Belgium

History

A 66-year-old male patient, complaining of evolutive exertional dyspnea for the past few months, presented himself for a cardiac check-up. He was once a heavy smoker but has not smoked for the past 7 years. He had moderate dyslipidemia, controlled by statin. The classical examinations, carried out at the consultation, were normal with exception of the bicycle-stress test, which showed objective dyspnea at the peak exercise of 110 watts without ECG abnormalities. Since the stress test was non-conclusive, CTA was proposed to complete the examinations.

Diagnosis

CTA images showed multiple calcified plaques in all three coronary arteries, most extensively in the proximal and mid segments of the LAD (Figs. 1 and 2). It was therefore impossible

to determine conclusively the severity of the stenosis. After the administration of adenosine, the ECG showed no significant abnormality at all. Stress perfusion images (Fig. 3) showed a significant reduction in the myocardial blood flow in the LAD territory, compared with the CFX or RCA territories. The findings depicted a significant ischemia in this region. In the cath lab, the mid LAD stenosis was confirmed and the patient was treated with percutaneous transluminal coronary angioplasty and stenting of the mid LAD with an excellent angiographic result (Fig. 4).

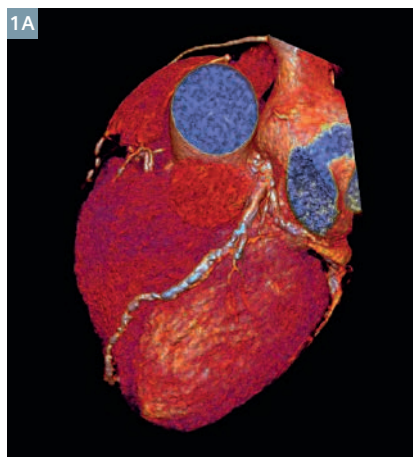
Comments

CTA can detect calcified plaques of the coronary arteries; however, the severity of the stenosis might not be interpretable if the coronary artery is extensively calcified. Adenosine-

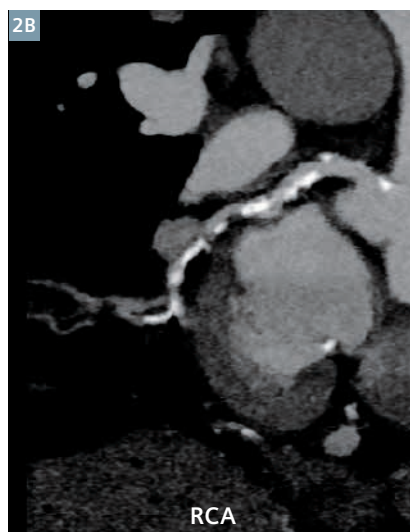
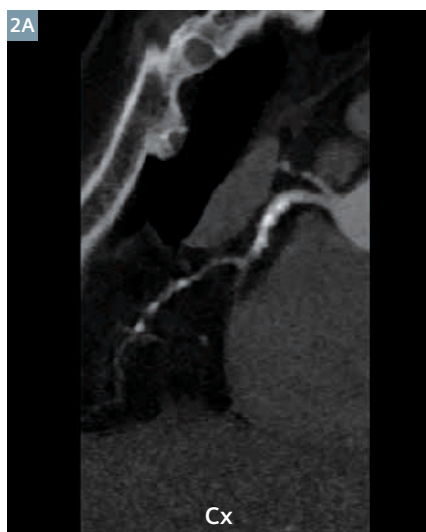
Stress Dynamic Myocardial CT Perfusion permits evaluation of the hemodynamic significance caused by the stenosis, and assists in the decision-making process for optimal patient treatment.

Examination Protocol

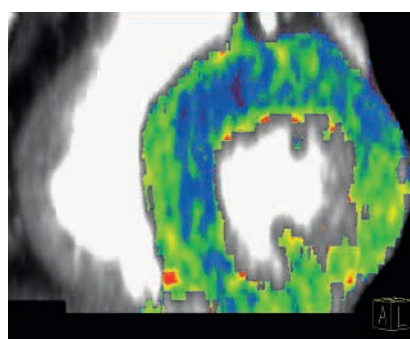
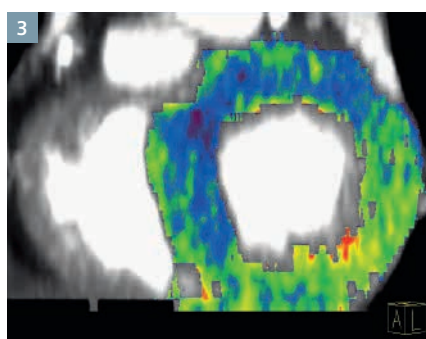
Scanner	SOMATOM Definition Flash
Scan area	Heart
Scan mode	VPCT
Scan length	70 mm
Scan direction	Cranio-caudal
Scan time	31 s
Tube voltage	100 kV
Tube current	125 eff. mAs
Dose modulation	CARE Dose4D
CTDI _{vol}	78.2 mGy
DLP	562 mGy cm
Effective dose	7.9 mSv
Rotation time	0.28 s
Slice collimation	32 × 1.2 mm
Slice width	3 mm
Reconstruction increment	2 mm
Reconstruction kernel	B23f
Contrast	
Volume	50 ml contrast + 40 mL saline
Flow rate	6 mL / s
Start delay	Determined by test bolus



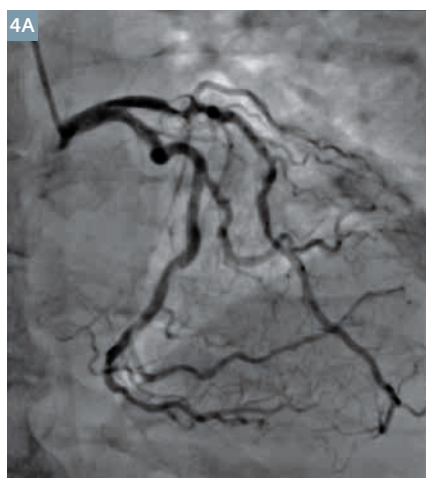
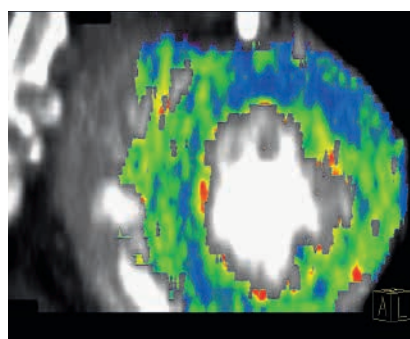
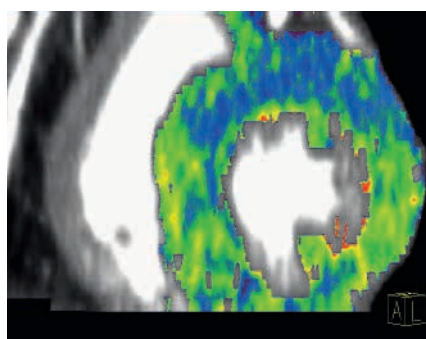
1 VRT (Fig. 1A) and curved MPR (Fig. 1B) images demonstrate the extensively calcified LAD.



2 Curved MPR images show multiple calcified plaques in Cx (Fig. 2A) and RCA (Fig. 2B).



3 Perfusion images reveal myocardial perfusion defects (in blue) in the LAD territory.



4 Angiographic images confirmed the mid LAD stenosis (Fig. 4A). The patient was treated with PTCA and stenting of the mid LAD with an excellent angiographic result (Fig. 4B).

Dynamic ^{82}Rb PET-CT Estimation of Myocardial Blood Flow as an Indicator of Post Angioplasty Reperfusion in Ischemic Viable Myocardium

By Dr. Parthiban Arumugam, MD, Manchester Royal Infirmary, Manchester, United Kingdom

Data courtesy of Manchester Royal Infirmary, Manchester, United Kingdom

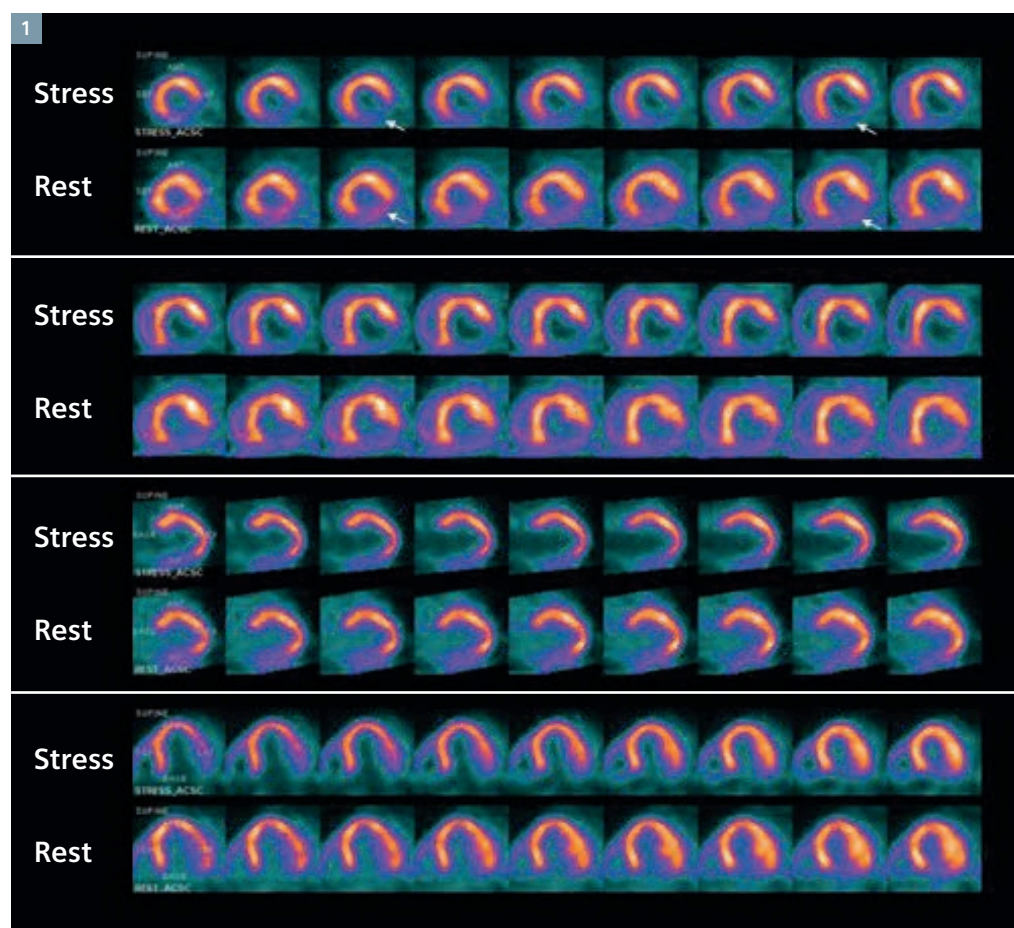
History

A 64-year-old male patient with intermittent angina presented for a PET myocardial perfusion study in March 2012. A dynamic ^{82}Rb PET-CT study was performed at rest and during Adenosine stress. The study was performed on a Biograph™ TruePoint 64, and the data was evaluated using syngo®. PET Myocardial Blood Flow

(MBF) software package for an estimation of Myocardial Blood Flow.

The PET myocardial perfusion study demonstrated severe stress-inducible reduction in perfusion in the inferolateral myocardium (arrows), with partial reversibility visualized in the resting images (Figure 1). The anterior wall, septum and most of the lateral

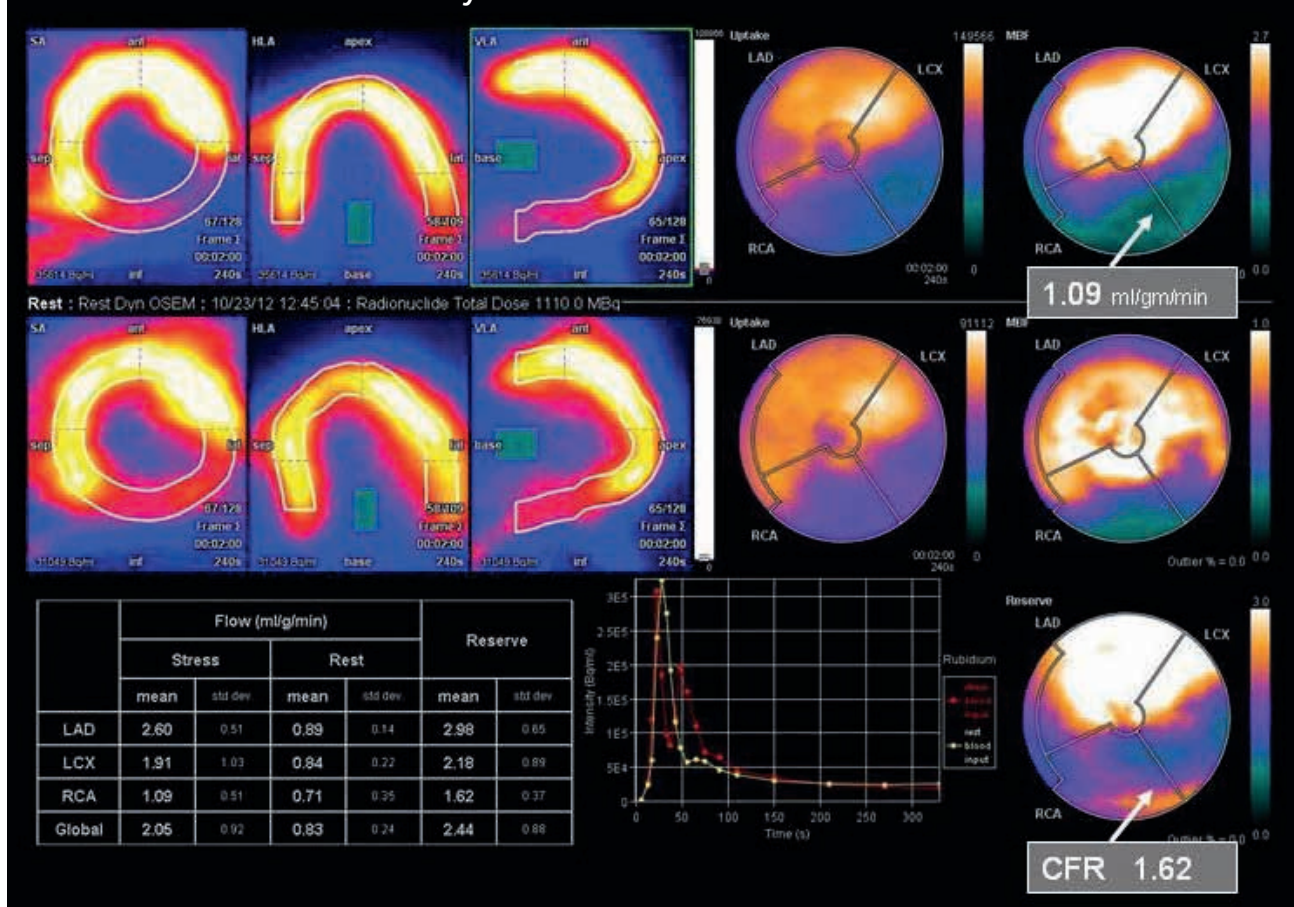
wall show normal perfusion. The left ventricle (LV) appears dilated in the post-stress images, reflecting the severity of ischemia. The persistence of the inferolateral hypo perfusion in the rest-study, with minor reversibility, reflects the severity of the right coronary artery (RCA) stenosis with gross resting hypo perfusion.



1 Stress/rest ^{82}Rb myocardial perfusion PET study performed in April 2012.

2

Myocardial Blood Flow Baseline



2

Myocardial blood flow and coronary flow reserve estimation using syngo.PET MBF software shows low-stress absolute flow rates and coronary flow reserve (CFR) in the inferolateral wall.

MBF was low in the inferolateral myocardium during peak stress (1.09 ml/gm/min in the inferolateral segment (arrows) compared to 2.6 ml/gm/min in the anterior wall, which is within normal limits). Also, resting blood flow in the inferolateral myocardium is significantly lower than that of the anterior wall. The myocardial flow reserve is 1.62 in the inferolateral segment, with the accepted normal value being more than twice the resting flow.

The patient underwent coronary angiography, which demonstrated tight RCA stenosis and occlusion of the distal circumflex artery. The perfusion

pattern correlates well with the angiographic appearance.

The patient underwent successful angioplasty of the RCA stenosis. A follow-up ^{82}Rb myocardial perfusion PET was performed after 1 year due to recurrence of symptoms. Stress/rest ^{82}Rb PET-CT was performed in April 2013.

Diagnosis

Compared to the initial images, the post-angioplasty perfusion study, performed 1 year later, also shows a partial improvement in perfusion to the inferolateral segments at peak stress. Perfusion at rest is, however,

significantly improved compared to the initial study, suggesting significant improvement in resting perfusion in the inferolateral myocardium.

Stress MBF in the inferolateral myocardium was 2.22 ml/gm/min, while the anterior wall was 2.91 ml/gm/min. Stress MBF in the inferolateral myocardium was significantly higher in the post-angioplasty study, compared to the initial study (1.09 ml/gm/min). Although, visually, there appears to be a reversible perfusion defect in the inferolateral myocardium in the post-angioplasty situation, the normal stress MBF is possibly a reflection of successful revascularization follow-

ing angioplasty. The resting MBF in inferolateral myocardium was comparable to the initial study. The myocardial flow reserve in the inferolateral segments (3.8) was significantly increased, which is higher than in the normally perfused segments (anterior wall CFR 2.51). In comparison, the CFR in inferolateral myocardium for the initial study was only 1.62.

Comments

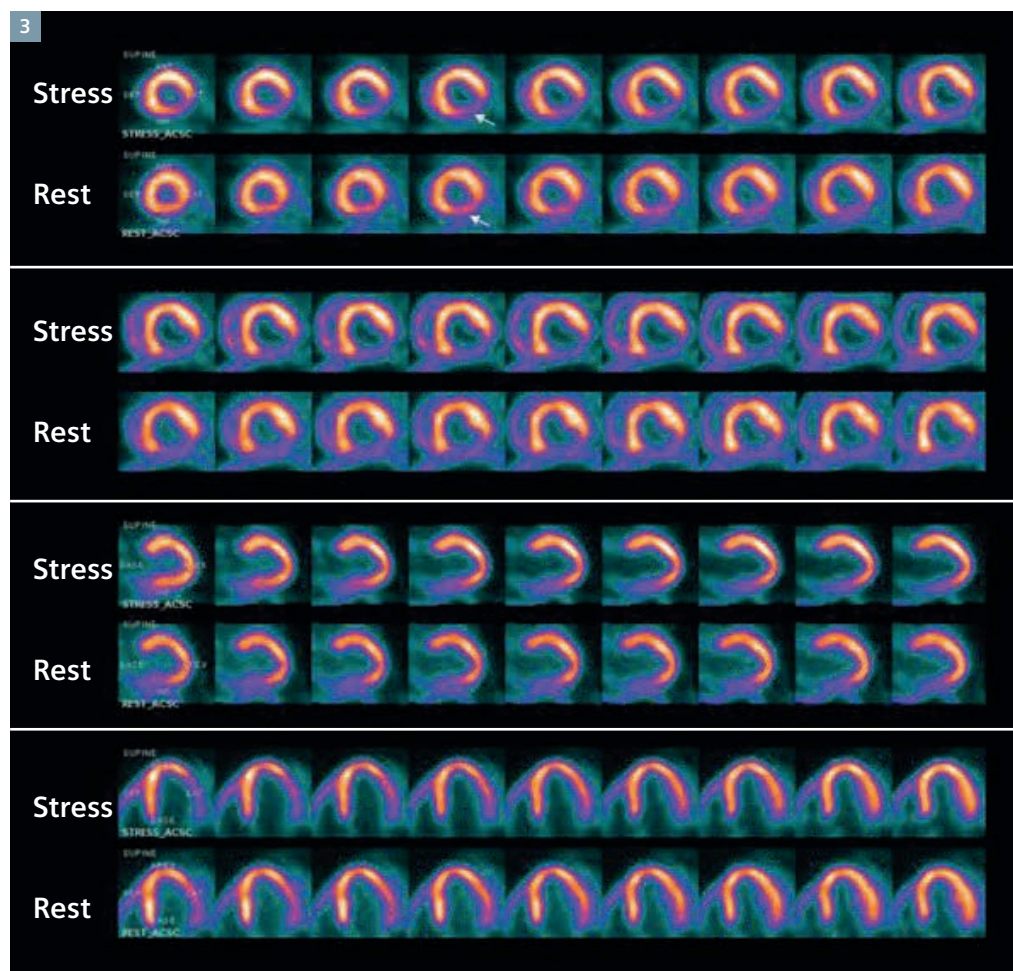
Because of the persistent relative stress hypo perfusion in the post-angioplasty study, the increase in CFR and stress MBF in the inferolateral myocardium is significant. Resting perfusion is not significantly different in pre- and post-angioplasty states. The asymmetric increase in CFR,

compared to the visual stress perfusion pattern in the inferolateral myocardium following angioplasty, may reflect the absolute increase in blood flow in the right coronary and the myocardial small vessels post-angioplasty, although the peak stress flow relative to the normal myocardium was lower leading to the visualization of hypo perfusion in the short axis slices. The significant increase in inferolateral myocardial CFR may be an early sign of successful reperfusion following angioplasty, even when myocardial perfusion in the ischemic area was below that of the normally perfused LV segments.

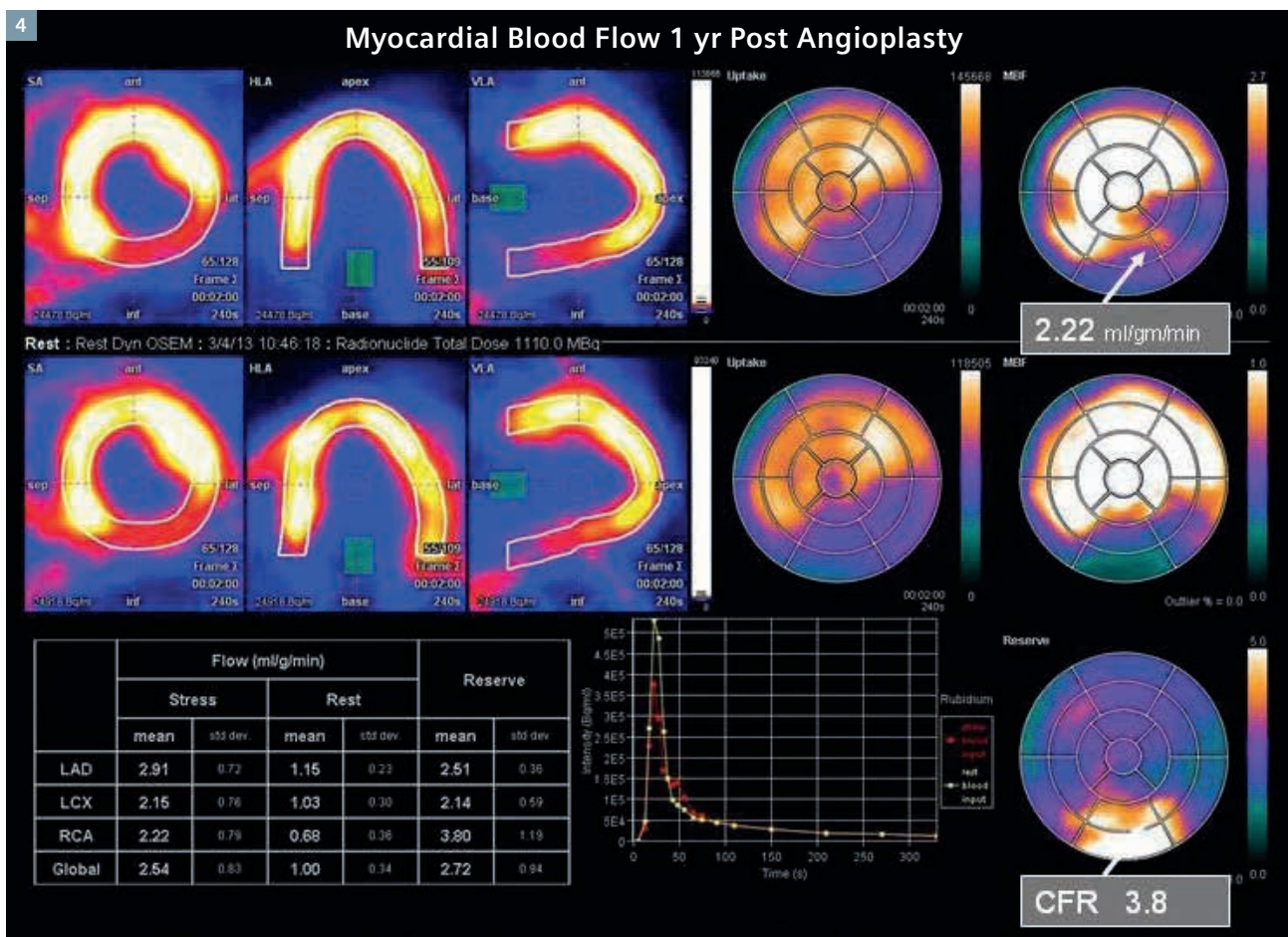
Gradual recovery of CFR in ischemic segments post angioplasty is demonstrated by PET. Neumann et al[1]

demonstrated that, in patients with acute myocardial infarction (MI) with successful recanalization of the occluded artery, CFR of the infarct region improves in most patients within 1 hour, and further improves within 2 weeks despite the persistence of a perfusion defect. Stewart et al[2], in a series of 21 patients with acute MI, demonstrated gradual and continuous improvement in vasodilator response and coronary flow reserve in infarct related myocardial regions following angioplasty using serial ^{13}N NH $_3$ PET studies.

The interesting aspect of this case is the high CFR in the inferolateral myocardium in a study performed 1 year following angioplasty. Since the RCA had a tight stenosis, recovery of myo-



3 ^{82}Rb PET-CT myocardial perfusion study shows a significant perfusion defect in the inferolateral myocardium with evidence of reversibility in the rest images.



4 Myocardial blood flow evaluation using syngo.PET MBF software shows normal blood flow values in inferolateral myocardium at peak stress with high CFR.

cardial perfusion in the affected vessel may be slow and resting perfusion may remain low for an extended period of time, as shown in this case. However, significant increase in vasodilator response, and in stress MBF, reflects the microcirculatory reactivity to stress, and the patency and vasodilatory capacity of the supplying vessel post angioplasty.

Examination Protocol

Scanner	Biograph TruePoint 64
Injected dose	^{82}Rb 40 mCi stress and 40 mCi rest injection
Acquisition	Dynamic list mode, CT low dose for CT attenuation correction

Value of Technology

Myocardial blood flow measurements using ^{82}Rb dynamic PET perfusion studies are helpful for quantitative assessments of coronary interventions, especially stents. MBF measurements with syngo.PET MBF software enable routine usage of such quantitative measurements due to the automated nature of the software and the ease of use.

References

- [1] Am Coll Cardiol. 1997 Nov 1;30(5):1270-6.
- [2] J Nucl Med. 1997 May;38(5):770-7.

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Improved Patient Outcomes

Blood Flow Visualization and Automated Heart Valve Quantification During Valve Procedures

The new ACUSON SC2000™ ultrasound system PRIME is the only premium cardiovascular imaging system in the market offering high frame rate true volume color Doppler imaging of heart valve anatomy and blood-flow using the new True Volume TEE transducer.

With this technology, physicians can obtain a more anatomically authentic view of the heart and understand physiology better with dynamic blood flow in one view during any valve procedures – even in patients with ECG abnormalities. This enables them to

make faster and more informed critical decisions.

Also introduced for the first time on the ACUSON SC2000 PRIME system is the eSie Valves™ advanced analysis package. While standard quantification software takes several minutes to provide measurements of heart valves, the eSie Valves package enables physicians to measure aortic and mitral valve anatomy during cardiac procedures in seconds. This quantitative information allows a quick and easy evaluation of valvular anatomy and physiology, aiding in device sizing and surgical repair.



A World First in Austria

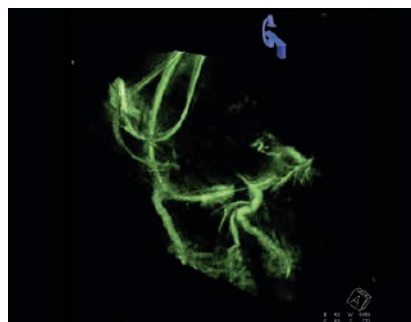
CRT Device Implantation based on 3D Visualization of Coronary Sinus via Untriggered syngo DynaCT Cardiac

Now it is possible to visualize the three-dimensional morphology of the coronary sinus (CS) derived from just one 5 s untriggered *syngo* DynaCT® Cardiac run. This anatomical information was found very useful for guiding the bi-ventricular pacemaker lead to the desired position within CS. It can also mean a reduction in radiation exposure to patients and interventionalists, and seeks to further improve the intervention quality.

Cardiac resynchronization therapy (CRT) is indicated and effective for advanced drug-refractory heart failure, severe LV systolic dysfunction, and ventricular dyssynchrony.

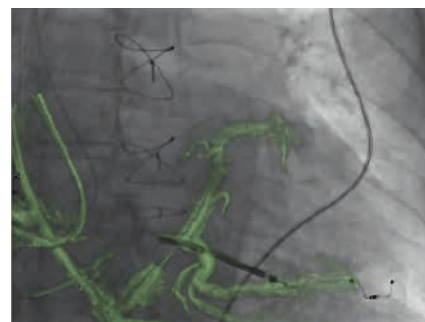
After successful implantation of a CRT device, patients may benefit from an improved quality of life and increased life expectancy including reduction in increased all-cause mortality.

Marcus Ammer, MD, from Hospital Wels-Grieskirchen in Austria is working with an Artis Q.zen system and *syngo* X Workplace to treat CRT



3D visualization of the coronary sinus. 248 projection images were acquired with a single 5 s rotational run during balloon occlusion of the coronary sinus. Retrograde manual contrast injection and right ventricular rapid pacing was applied during the 3D scan before automatic 3D reconstruction.

patients. For 3D reconstruction and 3D visualization of the coronary sinus, he uses *syngo* DynaCT Cardiac.



Super-imposition of the 3D anatomy of the CS on 2D live fluoroscopy images shows the pacemaker lead during implantation.

ESC Congress 2015

This year's ESC congress will take place in London, United Kingdom, from August 29 to September 02, 2015. Do not miss Siemens' Hands-on Tutorial Training Sessions during the conference.



Hands-on Tutorial Training Sessions

Cardiac imaging is rapidly developing, driven by the introduction of new imaging approaches like tomographic imaging in the interventional lab or real-time 3D echocardiography. In order to keep you updated in the field of state-of-the-art cardiovascular imaging, Siemens Healthcare will be providing a comprehensive set of Hands-on Tutorial (HoT) sessions during this year's ESC congress in London from August 29 to September 02, 2015.

You will have the opportunity to learn from renowned clinical experts how to perform and analyze real-time 3D echocardiography and comprehensive studies with cardiac CT and MRI. An experienced interpreter is also available to show you how to read cardiac single-photon emission computer tomography (SPECT) studies. In addition, Siemens also offers case-based learning sessions with detailed discussions on the role of imaging in CV care.

Be sure to visit our website to find the latest information on our program.

Further Information

www.siemens.com/esc



Find the detailed HoT program on our website starting May 2015.

Contact

carsten.lauer@siemens.com

Cardiology Education

Continuing education is a major pillar of Siemens' dedication to ever better healthcare. The wide spectrum of cardiology offerings includes clinical fellowships, clinical workshops with leading experts in their fields, e-learning and application trainings from basic to advanced level, empowering users to tap the full potential of their systems and to improve their clinical and financial outcomes.

Name of Training / Event / Fellowship, Place	Target Groups	Date / Duration	Language	Content / Short Description Link to more information / Registration
Interventional Cardiology				
Fellowship Interventional Cardiology, City Hospital of Schweinfurt	Cardiologists, Radiographers & Technicians	3–5 days	German / English	AXIOM Artis dBC with AXIOM Sensis XP www.siemens.com / Interventional-Fellowships
Fellowship Interventional Cardiology, University Heart Center Leipzig	Cardiologist, Cardiac Surgeons, Radiographers & Cardiology Nurses	3–5 days	German / English	Artis zee biplane & Artis zeego www.siemens.com / Interventional-Fellowships
Fellowship Interventional Cardiology, Hospital Darmstadt	Cardiologist, Radiographers & Cardiology Nurses	3–5 days	German / English	Artis zee floor & Artis zee biplane www.siemens.com / Interventional-Fellowships
Fellowship Pediatric Cardiology, University Hospital Erlangen	Pediatric Cardio- logist, Pediatric Cardiac Surgeons, Radiographers & Pediatric Nurses	3–5 days	German / English	Artis zee biplane www.siemens.com / Interventional-Fellowships
Fellowship Rhythmology / Electro- physiology, University Heart Center Leipzig	Cardiologist, Cardiac Surgeons, Radiographers & Cardiology Nurses	3–5 days	German / English	Artis zee biplane system with MediGuide www.siemens.com / Interventional-Fellowships
Fellowship Surgery, University Hospital Heidelberg	Vascular & Endo- vascular Surgeons	3–5 days	German / English	Artis zeego www.siemens.com / Interventional-Fellowships
Fellowship Surgery, Center for Cardiovascular Diseases Rotenburg a.d. Fulda	Cardiac & Vascular Surgeons, Radiologists & Cardiologists	3–5 days	German / English	Artis zeego www.siemens.com / Interventional-Fellowships
Introductory Course in Interventional Cardiology, Hands-on training vascular models and virtual-reality simulators, Cardiac Department, National University Heart Centre, Singapore	Physicians with little or no experi- ence in interven- tional cardiology	April 2015	English	Seminar and individual hands-on- training with basic information of interventional cardiology / kellie.koh@siemens.com
Cardiovascular CT				
Optimized TAVI Procedural Planning: CT and Angiography, Erlangen, Germany	Cardiologists, Radiographers	March 10, 2015	English	www.siemens.com / SOMATOMEducate
Advanced Cardiovascular CT, Frimley, United Kingdom	Cardiologists, Radiographers	May 19 –22, 2015	English	www.imperial.ac.uk
Coronary CTA Interpretation Workshop, University of Erlangen, Germany	Cardiologists, Radiographers	Nov 12 –13, 2015	English	www.siemens.com / SOMATOMEducate
Cardiovascular MR				
Advanced Cardiac magnetic resonance evaluation (Hands-on Tutorial), ECR 2015, Vienna, Austria	Cardiologists, Radiologists	March 4 –8, 2015	English	www.siemens.com / ecr
10th Clinical Update on Cardiac MRI & CT (Congress), Cannes, France	Cardiologists, Radiologists	April 16 –18, 2015	English	cardiacmri-ct.medconvent.at

Name of Training / Event / Fellowship, Place	Target Groups	Date / Duration	Language	Content / Short Description Link to more information/Registration
Cardiovascular Lab Diagnostics				
A Woman's Heart – Unique Features of Cardiovascular Health and Disease in Women, Online Webinar	Laboratorians / Clinicians	On demand	English	www.siemens.com/cvd-and-women
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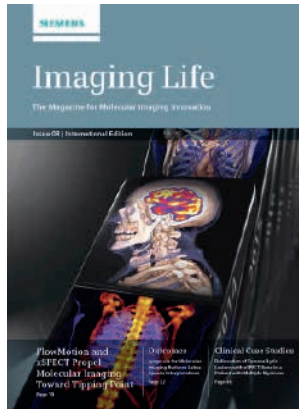
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