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Interactive VR worlds in healthcare

Metaverse in medicine: between potential and pioneering spirit

For many, the term "metaverse" evokes images of VR headsets and the rebranded company behind Facebook – but can the digital parallel universe provide actual benefits for healthcare? Dr Anke Diehl has studied the technology intensively and recognises significant potential for medical applications. However, the expert for digital transformation at Essen University Medicine, Germany, cautions clinicians to bring a healthy dose of pioneering spirit when exploring the technology.

Digital clinical environments can be created in the metaverse, where many limitations of real-life hospitals do not apply.

At the Medica Health IT Forum, Dr Anke Diehl briefly made her audience see double: the expert, standing on the speaker's podium, suddenly also appeared in a virtual operating theatre on-screen. With a few inputs, she manoeuvred her digital alter ego within the 3D environment, operating devices, checking clinical values, and interacting with others in the OR.

After all, interactivity is a key feature of the metaverse: unlike many other VR worlds, it is designed for user exchange and joint activities. It is by no means a coincidence that Meta, the company behind Facebook, WhatsApp and Instagram, has positioned itself to be the most prominent player and driving force for this technology. Social interaction lies at the very core of the metaverse DNA, with some even regarding it as the logical expansion of social media.

Team-up in the avatar hospital

But does this virtual cooperation also work in a medical context? Currently, Dr Diehl and her team are getting to the bottom of this question. 'For this, we have built an avatar hospital – with some locations resembling actual clinical facilities, and others that only exist in the metaverse, where you can showcase 3D projections, for example,' the expert reports. 'At first, many of the locations were inspired by the Covid-19 pandemic; we were looking for new ways to meet colleagues and discuss with them.' To this end, 3D models were created to serve as avatars for the employees, which they can use to move freely within the digital environments. 'For example, I can direct my avatar onto a virtual stage to deliver a presentation, looking at the digitized versions of my colleagues sitting in the audience. Exactly this kind of spatial experience is a vital part of the technology.'

The virtual spaces are mostly accessed via desktop PCs using mouse/keyboard controls. 'The metaverse is often associated with VR headsets, but that would be too costly in our context. And it's not really necessary, either,' Diehl explains. Immersion – the sense of "being there" in the virtual realm – is instead achieved by using small animations for the avatars. 'For example, when a user talks, the character's mouth is moving and using gestures to convey the action.' This type of interactivity could also benefit doctor-patient communication, the expert suggests.

Added value for students and paediatric patients

However, the clinical test metaverse is far more than a glorified 3D conference call, she stresses: 'We see a lot of added value in medical education. For example, the teacher can assume the role of a patient avatar for practising anamnesis interviews. Due to the immersive nature of the metaverse, students quickly forget that they are interacting with their teacher, and the situation loses its test character – which, for many students can feel rather intimidating.'

During a recent AI event in Essen, hospital visitors were also able to gain insights into the medical metaverse. Meanwhile, several research projects established benefits of the technology, especially for paediatric patients – for example, to help children overcome their fears of the unfamiliar hospital environment and its instruments. One study provided the young patients with assistance from the "Penguinauts" app; before an MRI scan, the virtual characters prepared the children for the noisy machine and encouraged them to brave the examination.

Another VR game currently in trial phase addresses paediatric patients undergoing chemotherapy, placing them, along with their parents, in an underwater setting. 'In the game, the child is wearing a deep-sea diving suit, exploring the surrounding fish and interacting with them,' Diehl explains. 'At a certain point, the doctor gives a signal, for example when a disinfectant is applied. However, in the game, it's just a small leak in the suit, so the child is not scared of the sudden cold sensation.' For the expert, this "gamification" approach is one of the technology's biggest strengths – a notion that is backed by the study's promising intermediary results.

Doctors in the metaverse? Only if the benefits are clear

Despite most metaverse apps being geared towards a younger audience of "digital natives", Diehl does not believe that the technology has an inherent generation gap: 'The most important factor is being open-minded towards new things, which has no age limit, in my experience. For many doctors, the pivotal element will be whether the technology works and bears medical benefits. If that is the case, they will adopt it.'

That said, the expert encourages any colleague to bring a certain willingness for tinkering, as many aspects are still noticeably rough around the edges: 'We are currently trying out many applications – some work better than others, due to the technology not being sufficiently matured.' One notable limitation, she points out, is that vital parameters – such as ECG curves, diagnostic imaging or blood levels – cannot be displayed in real time on the metaverse's virtual monitors. While such a feature would greatly enhance educational settings with virtual patient models, it poses a significant challenge for both technology and data privacy requirements. 'We are still a long way from building a viable IT infrastructure and the legal frameworks to support this,' the expert concedes.

The future: digital complementation of established procedures

'The metaverse is certainly not the future of healthcare,' Diehl is convinced. 'For us, patient care has the highest priority, with no one being left behind. So, whenever a person is unable or unwilling to use the technology to participate in a digital treatment, we must provide an analogue alternative. This will not change anytime soon.'

Still, in times of medical staff shortages, the technology has great potential, the expert says: 'We are desperately looking for new ways to provide care and therapies – for example via telemedicine – and in this regard, the metaverse could prove to be a valuable addition to our clinical toolset.' ■

Dr Anke Diehl

Dr Anke Diehl is Chief Transformation Officer and Head of the Executive Department for Digital Transformation at University Medicine Essen, Germany. In this role, she is in charge of realizing the institution's "smart hospital" strategy. Since March 2021, she also leads the consortium "Smart Hospital.NRW" cluster of excellence for AI in medicine. As a doctor, she worked in radiology, neurology, neuroradiology and psychiatry before moving to work for the state of North Rhine-Westphalia in 2010, where she headed the department for care structure development until 2018. In addition to digital medicine, she is currently working on gender issues in AI and digitalisation and is the winner of the 2021 Medical Woman of the Year Award. She further represents health IT users on the national expert committee Interop Council and is a member of the German Medical Association's Digitalisation Committee.

Report: Wolfgang Behrends

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Photon-counting CT, strain imaging, 4D flow MRI

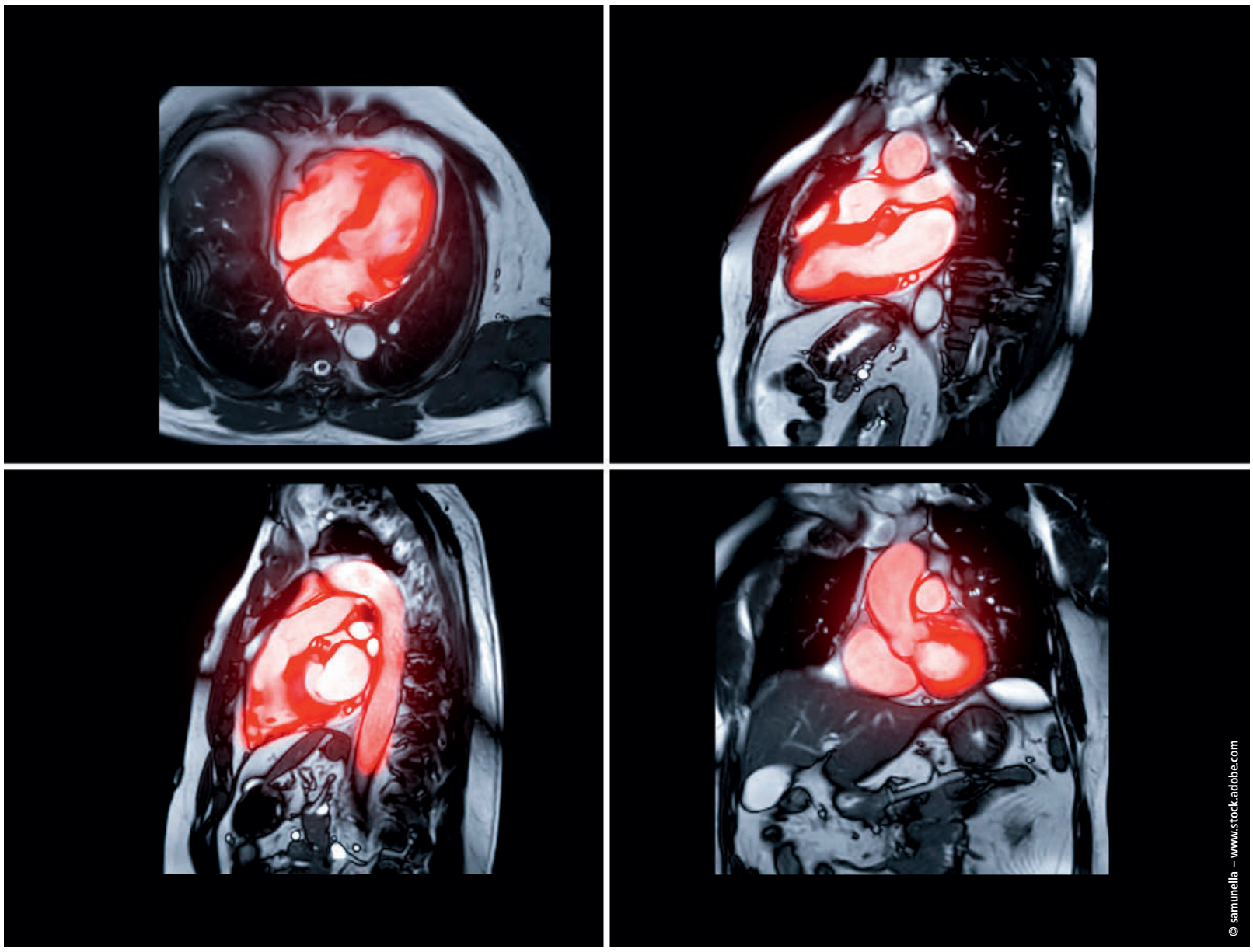
How new technologies shape the future of cardiovascular radiology

New approaches to cardiovascular radiology are evolving to help clinicians gain an increasingly better insight into heart conditions. Latest developments in cardiovascular radiology include myocardial strain imaging, 4D flow and photon-counting CT technology.

An ECR 2024 session shone the spotlight on these areas of cardiovascular imaging with expert speakers outlining the pros and cons of each.

Dr Hatem Alkadhi, Vice Director of the Department of Diagnostic and Interventional Radiology at University Hospital Zurich in Switzerland, explained that photon-counting CT offers two advantages: spectral information and ultra-high resolution.

He said the inherent spectral information is always available, thanks to the dual source principle of the scanner, at the highest available temporal resolution. 'That means we can do several post-processing issues – reconstruct virtual monoenergetic images, subtract calcium from iodine and look at the myocardium at high quality. The ultra-high-resolution mode is very interesting for dense calcifications, plaque imaging and visualisation, stenosis quantification and coronary stents imaging.'



Cardiac MRI

PCCT: Promising, but not without flaws

Alkadhi said one of the biggest benefits of spectral data acquisition is the images are virtual mono-energetic. He pointed to study results comparing patients scanned with a third-generation dual source conventional energy integrating detecting CT machine and then with a photon-counting detector CT, which showed clear benefits of the new technology. With matched protocols, radiation dose and contrast media, the photon-counting CT delivered 'a net increase in contrast to noise ratio (CNR) of up to 70% when you look at vascular imaging.' That translates into improvements in image quality with lower contrast media.

He concluded: 'We have excellent performance characteristics for photon-counting detector CT for cardiovascular imaging in regard to signal, noise and CNR, which we can use to improve image quality and/or save contrast media, which may be important in vulnerable patients.' There do, however, remain issues over which scan mode to apply in which patient – spectral or ultra-high-resolution acquisition – or both, and which is best for assessing the stenosis. He noted that the PureLumen algorithm for virtual calcium removal still needs to be more robust to be applied in clinical routine.

Myocardial strain imaging: hearts in motion

Radiologist Dr Tilman Emrich from the Department of Diagnostic and Interventional Radiology at the University Medical Center in Mainz, Germany, highlighted the benefits of myocardial strain imaging, its applications and how it can be used as an imaging biomarker.

'Strain imaging is all about deformation, the alteration of shape or volume of body by a force,' he said. 'This is happening in the heart while it contracts. We see the alteration of volume by the contraction and we can measure this deformation in several parameters.'

This, he continued, can connected to different layers of the heart muscle which have different properties and are responsible for certain motion aspects in the heart. 'The 3D motion pattern can be divided into longitudinal, circumferential (rotation) and radial patterns and we can look at these deformation patterns and try to connect which layer of the muscle is affected,' said Emrich.

Strain images enables cardiac radiologists to conduct segmental analysis, such as in myocardial infarction, and the detection of subclinical changes of the left ventricle, e.g. in genetic diseases or after treatment with chemotherapy. In addition, strain imaging offers insights into prognostic effects of various cardiomyopathies.

While acknowledging that myocardial strain imaging offers a number of insights and is highly promising, Emrich said there is a need to standardise the technique before it can be used as a clinical tool.

4D flow: fluid mechanics with solid potential

Dr Ursula Reiter from the Department of Radiology at the Medical University of Graz in Austria discussed how 4D flow is a valuable tool in state-of-the-art cardiac MRI. It provides simplified acquisition and accurate quantification as a time-resolved, three-dimensional, three-directional, velocity encoded phase contrast imaging. The four sequences enable calculation of the 3D velocity through the cardiac cycle, supported by guidelines and expert recommendations on how to adapt these protocols with respect to spatial and temporal resolution. 'We can use these parameters of elevated stress as possible risk stratification,' she added.

Summarizing her insights, Reiter pointed out that 4D flow can be relatively straightforward to assess with a whole heart body flow conducted within 10 minutes. She added that 4D flow allows visualisation of flow patterns and accurate velocity quantification and flow quantification can be performed through any a posteriori defined cross section. '4D flow allows calculation of unique fluid mechanical parameters, though the full diagnostic/prognostic potential still has to be explored,' the expert concluded. ■

Report: Mark Nicholls

Professor Hatem Alkadhi

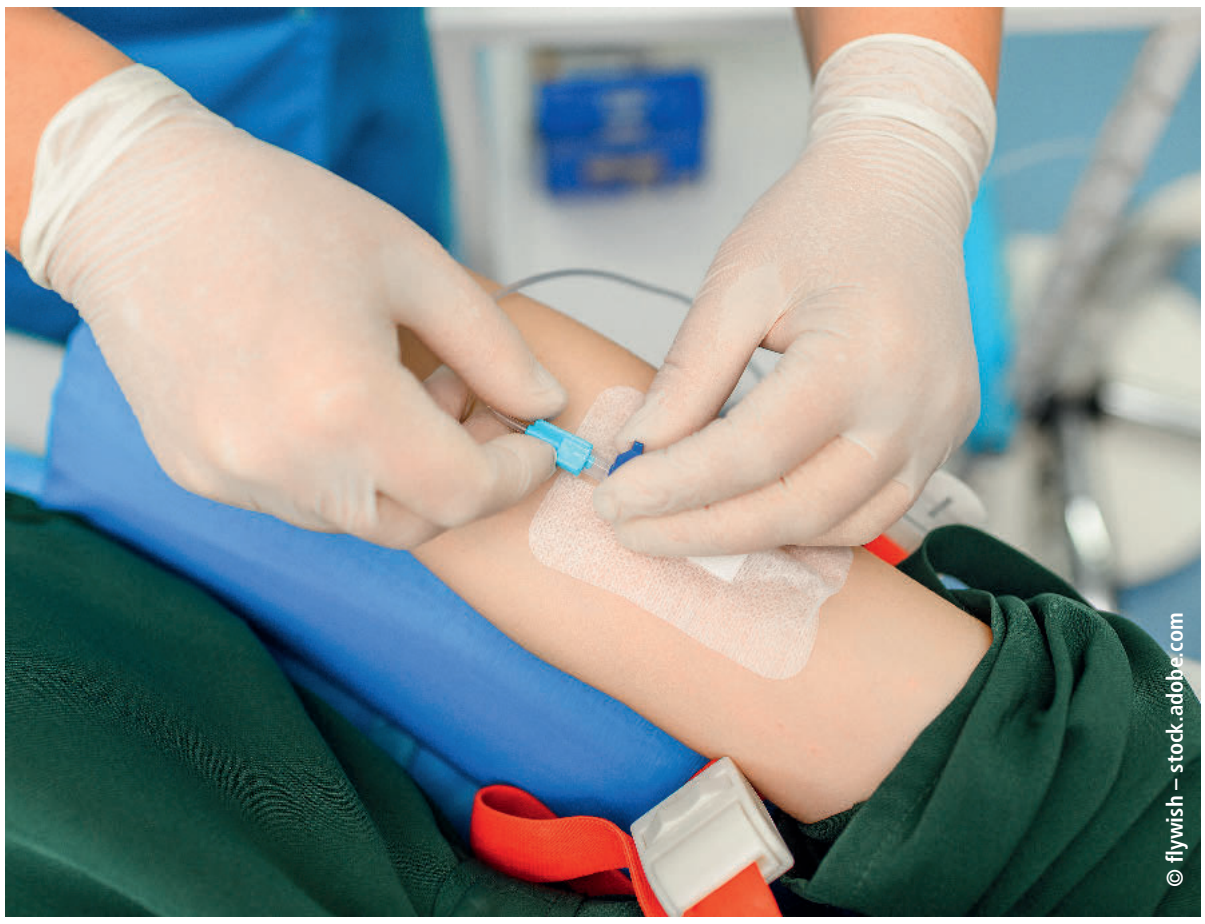
Professor Hatem Alkadhi is Vice Director of the Department of Diagnostic and Interventional Radiology at University Hospital Zurich in Switzerland. His specialist areas are multimodal cardiovascular imaging, emergency radiology and computed tomography.

Dr Tilman Emrich

Dr Tilman Emrich is working as an attending radiologist specializing in cardiovascular imaging at the University Medical Center Mainz, Germany. In parallel, he serves as an Adjunct Assistant Professor of Radiology and Director of Photon Counting CT Research at the Department of Radiology and Radiological Science, Division of Cardiovascular Research, Medical University of South Carolina, USA.

Medical imaging

Latest developments in contrast media utilisation



Striking the balance between diagnostic efficacy and patient safety remains critical when utilising iodinated contrast media to deliver the best imaging outcomes. Currently, 300 million CT exams are conducted across the world every year, with 40% contrast-enhanced exam. While playing a crucial role in diagnosis and treatment of disease, CT expert Efthimios Agadakos believes the medical profession has a duty to do its utmost to minimize patient risk from contrast media.

A session at ECR 2024 in Vienna heard about latest developments, trends and breakthroughs in contrast media utilisation in CT, MRI and ultrasound imaging, and explored the question of how dosage may be further lowered using modern protocols. Focussing on CT imaging, Agadakos offered insights into approaches he feels can contribute to enhanced patient safety and better-informed clinical decisions.

As Chief Radiographer at Laiko General Hospital in Athens, he highlighted the role of imaging in modern clinical practice, offering invaluable diagnostic information across a wide spectrum of medical specialities. 'It can improve visualisation of anatomy and pathology, enhance lesion detection and vasculature, identify ischemic conditions, enhance surgical planning and guidance as well as monitoring treatment response,' he said. 'But it is imperative to acknowledge the associated risk of iodine in contrast media.'

Why a lower dose matters

Risks from radiation levels and adverse reactions mean that optimal iodine delivery is pivotal in yielding precise and reliable diagnosis, while maintaining patient safety and healthcare efficiency. Agadakos said that lower iodine dose can reduce risk of allergic reactions and contrast-induced nephropathy, decrease vascular complications, enhance patient comfort and experience, minimise radiation exposure, and optimise resource utilisation. Protocols can also be adapted for children, the elderly and for patients that need repeat CT scans.

The expert went into detail on a range of options that can be applied to help reduce iodine dose when using CT. These include tube voltage selection (automated or manual), iterative reconstruction algorithms, cinematic rendering, Dual Energy CT, AI applications, Photon-counting CT, personalized protocols and smart injection systems. 'Iterative reconstruction algorithms enable the use of lower tube currents or voltages, driving lower iodine doses without diagnosing compromising diagnostic accuracy,' he told delegates.

One study using a low KV and low iodine dose with abdominopelvic CT achieved a 40% iodine dose reduction and 50% radiation dose reduction. 'Meanwhile, dual-energy CT allows for better iodine contrast enhancement at lower doses, thus reducing the total iodine load on the patients,' added Agadakos.

Perfect timing

Artificial Intelligence applications assist in reducing need for IVCM (intravenous contrast media) by analysing patient data such as and flow weight, select low KV or dual-energy CT scanning based on individual patient characteristics. When using personalized protocols, he said bolus triggering is a "must" with contrast-enhanced CT as it facilitates 'perfect timing for contrast enhancement, produces accurate imaging and reduces the need for higher iodine concentrations.' Meanwhile, photon counting CTA facilitates lower iodine dose by enhancing the detection of contrast media, particularly in small vessels, he added.

Finally, advanced contrast injectors equipped with intelligent technologies offer precise management of contrast administration. Agadakos said the aim is to strike a balance between diagnostic efficacy, image quality and patient safety and comfort. 'By embracing the latest advancements in CT technology and adopting tailored strategies for iodine dose reduction, we can push the boundaries of diagnostic excellence while prioritizing patient safety,' he continued.

'But we must continue to collaborate, innovate, and elevate the standard of patient-centred care in medical imaging, ensuring that every patient receives the highest quality of care and a positive and reassuring experience in the CT department.'

The session also heard from Peter Murphy, Unit Manager, MRI, PET CT & DXA, Alliance Diagnostic Medical Imaging Ireland and Cork University Hospital about current issues with Gadolinium-Based agents with MRI, and Barbara Kraus from Wolkersdorf, Austria, speaking on indications and protocols for ultrasound contrast agent administration. ■

Report: Mark Nicholls

Efthimios Agadakos

Efthimios Agadakos is the chief radiographer of the Medical Imaging Department at Laiko General Hospital, Athens, Regional Director Europe ISRRT (International Society of Radiographers and Radiological Technologists) and President of the Panhellenic Society of Radiological Technologists Greece. His areas of interest are in CT, radiation protection and patient safety. Awarded a MSc in Health Services Management from the National School of Public Health in Athens, he is currently completing his PhD thesis in Medicine at the University of Athens on low radiation dose protocols in CT.

Technology applications in diagnostic imaging

How digital twins will support the radiologist of the future

Digital twin technology can transform clinical practice by aiding patient-specific prediction and supporting personalized treatment models. Expert speakers at an ECR2024 session in Vienna focussed on how radiology will play a leading role in the advance through data acquisition via a range of imaging modalities.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The session was chaired by radiologist Professor Valeria Panebianco from the Sapienza University of Rome, who also outlined her department's work with digital twin technology.

To set the stage, she provided a rough definition of what a digital twin can be:

- an evolving digital profile that helps optimise digital performance;
- a dynamic digital representation; or
- a virtual representation of a physical object or system across its lifecycle.

The key concepts are that the two systems – physical and digital – should exist side by side on a real time basis.

Panebianco said: 'As simulation models, digital twins will transform clinical practice as they will provide patient-specific prediction for the prevention, screening and disease diagnosis as well as personalization and assessment of response to therapy.'

Bridging the human-digital divide

The expert delivered insights on the future development of digital twins in radiology through clinical, computational, digital and virtual pathways, noting that it is 'where the real clinical world meets digital'. However, the complexity and prognostic heterogeneity of diseases make it necessary to apply computational tools and precision medicine.

'The data for digital twins' development can be derived from many different medical specialities,' she continued. 'However, radiology stands out for multiple factors as radiologists make diagnoses and assess therapy response, which are the main predictive clinical questions to which digital twins have to reply.'

Radiology produces large amounts of data from different modalities such as CT, MRI and ultrasound, providing a rich foundation for quantitative and functional information. To achieve the goal of making viable predictions, the data fed to the digital twins must be accurate as well, Panebianco said.

She pointed to current examples of digital twin applications, such as in cardiology to inform on clinical decisions, in orthopaedics to maintain musculoskeletal health of soldiers, and in multiple sclerosis for simulation models for treatment outcomes.

Outlining the work to develop digital twin technology at the University of Sapienza, she said her focus is on validating wearables, liquid biopsy and imaging biomarkers in prospective studies to construct the digital twin.

She concluded: 'Radiology is able to provide a bridge between the human being and the digital twin by shortening the gap and enhancing the development of this innovative digital solution.'

Efficiency, personalization, research

Meanwhile, Huan Xuan Nguyen, Professor of digital communication in engineering at Middlesex University in London and Director of the London Digital Twin Research Centre, went into more detail on what he called the "three pillars" of digital twins in healthcare:

- models developed for healthcare facilities and organizations, designed to improve efficiency of hospital or departments;
- digital twins of the human body for personalized diagnosis, treatment planning, treatments and interventions; and
- models geared towards disease research, medicine and device development.

However, he cautioned that implementation of digital twins in healthcare come with high deployment and maintenance costs, with significant investment needed in technology platforms to achieve viable results.

Nguyen also outlined technical challenges, with notable issues around data collection and integration, computational resources, model accuracy and validation, as well as privacy and security concerns. The effort needed to overcome these challenges might still be worth it, he added: 'The benefit in healthcare and radiology is that you can have greater predictive accuracy with a digital twin, treatment plan optimisation and can test scenarios without interfering with real patients.

'It can also be used for research and training and to familiarise patients with equipment. Finally, personal care and treatment is one of the most important potential benefits of the digital twin.'

Need for a regulatory framework

Dr Ilena Rapisarda, a private law researcher from the Department of Law at the University of Catania in Sicily, explored ethical and legal issues of digital twin technology.

While the technology's development might still be in its infancy, the field is rapidly evolving, she said: 'Clinicians will be able to simulate aspects of treatments on patient digital twins and determine which option is likely to be the most effective.

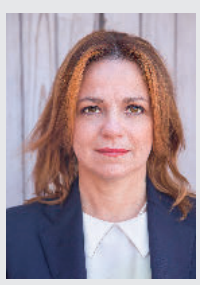
'Digital twin technology offers great opportunities to revolutionize healthcare systems, and ethical issues should not prevent development of such technologies but should integrate with it.'

However, the expert warned that conflicts of interest must be regulated by adopting an ethical approach, with the new technologies governed by the law. She said it was necessary to adopt an appropriate regulatory framework, especially regarding the allocation of responsibilities between the different actors involved in the production and use of digital twins. The framework should also introduce ethical principles of autonomy, responsibility and transparency in codes of conduct and training courses for engineers, computer scientists and developers, with particular reference to ethics in the design of technologies. ■

Report: Mark Nicholls


Huan Xuan Nguyen

Huan Xuan Nguyen is Professor of digital communication in engineering at Middlesex University in London and Director of London Digital Twin Research Centre, with research interests include that include digital twin modelling, digital transformation and machine learning.


Valeria Panebianco

Valeria Panebianco is Full Professor of Radiology at the Sapienza University of Rome with a specialist interest in diagnostic imaging focused on GU, screening programmes and precision medicine. She is scientific co-ordinator of a range of projects on digital medicine applications in healthcare.

Liver, renal, pancreas, paediatric and multi-organ transplants

Important role for ultrasound in transplantation imaging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Ultrasound plays a pivotal role in the assessment of organ transplant patients. It enables physicians to safely and easily assess progress, identify complications and resolve problems, as well as deliver long-term monitoring. The value of ultrasound in the transplant space was highlighted in a session at ECR 2024, covering liver, renal, pancreas, paediatric and multi-organ transplants with clinicians discussing how it enables them to offer better care for their patients.

Session co-chair Paul Sidhu, Professor of Imaging Sciences at King's College London, said that in the 1980s before the much wider use of ultrasound, physicians had little to guide them if a problem arose with a transplant such as with an abnormal liver test function, clotting, thrombosis, or organ rejection. 'But the introduction of ultrasound transformed how they managed patients,' he said. 'They could then clearly move into a different direction – immunosuppressant therapy, angiography, or revascularization.' The expert argued that, while ultrasound imaging has become a vital part of transplantation, it should be performed more still, and everyone should have the knowlegde of how to do this.

Detecting complications

Dr Gibran Timothy Yusuf from King's College Hospital NHS Foundation Trust – one of Europe's biggest transplant centres, conducting 200 liver transplants a year – highlighted how ultrasound in liver transplantation offers an understanding of the anatomy and potential complications, including the hepatic artery and vein, the portal vein and biliary duct.

'Ultrasound lends itself very well to that evaluation,' he said. 'One of the best ways to look at how to use ultrasound is by thinking what the complications can be and how we can potentially detect them.' This includes vascular complications including formations of pseudoaneurysm, stenosis or occlusion of major vasculature, stenosis of bile ducts, reflux and microlevel ischaemia angiopathy. 'Ultrasound has a role in the early follow-up, and then also longer term with rejection or recurrent disease,' he added.

Yusuf also outlined the importance of knowing when to use other modalities for an accurate imaging assessment, particularly when needing to view a wider area.

However, he pointed to the clear benefits of ultrasound; it is radiation free, has bedside use, is repeatable, accurate, safe and can be conducted in real time with uses including angiographic assessment, micro- and macrovascular perfusion dynamics.

He said: 'Multiparametric ultrasound provides comprehensive liver assessment, and the role of B mode and Doppler is critical. CEUS is useful for problem solving, particularly in the early follow-up period. There is a developing role with sheer wave elastography, though we must also acknowledge that complimentary imaging may be needed.'

Paediatric transplants: a wholly different ballgame

Dr Annamaria Deganello, a consultant radiologist at King's College Hospital since 2013, discussed paediatric liver and multi-visceral transplantation. She focused on the main surgical techniques, post-surgical complications and the role of ultrasound in the post-operative monitoring of paediatric transplants.

She said: 'There is a major difference between paediatric and adult transplantation and the grafts that children receive are very different from the grafts used in adults.'

Deganello said ultrasound, specifically Doppler, remains the most powerful tool to follow these patients up. 'CEUS microvascular imaging can be used in doubtful cases, especially because you are dealing with tiny vessels,' she added. 'But what is really beneficial is that when you are scanning patients, the parents are with you, and you can reassure them immediately rather than waiting for a CT.'

"An excellent problem solver" for renal transplantation

Professor Thomas Fischer, Head of the Ultrasound Centre at Charité in Berlin, concentrated on the monitoring strategy of the early phase after kidney transplantation using MPUS, the benefits of elastography, new broadband Doppler techniques, and CEUS in the early phase after transplantation.

He said that ultrasound is the most common modality for assessing kidney transplants and has a role in the post-operative phase from the first 48 hours through to longer term follow-up and is 'an excellent problem solver'.

Dr Jose Angel Jimenez Lasanta from Hospital Vall d'Hebron in Barcelona discussed ultrasound in the realms of combined kidney and pancreas transplantation. He discussed the role of ultrasound, including Doppler, in assessing renal/pancreas transplants and indicted when to turn to other imaging modalities for assessment. ■

Report: Mark Nicholls


Gibran Timothy Yusuf

Dr Gibran Timothy Yusuf is Consultant Interventional Radiologist at King's College Hospital NHS Foundation Trust. He also has a specialist interest in abdominal imaging and ultrasound, including advanced techniques such as contrast enhanced ultrasound, elastography and fusion for which he regularly publishes and is an invited speaker.


Annamaria Deganello

Dr Annamaria Deganello is a consultant radiologist at King's College Hospital, having qualified in 2004 from the University of Padua in Italy before undertaking specialist radiology training. Her specialist interest is in paediatric imaging of complex surgical cases, trauma and hepatobiliary diseases and liver transplantation.


Paul Sidhu

Paul Sidhu is Professor of Imaging Sciences at King's College London and a Consultant Radiologist in the Department of Radiology at King' College Hospital. He has published extensively on many aspects of ultrasound and pioneered the introduction of contrast-enhanced ultrasound in the UK. He is Past-President of the European Federation of Societies in Medicine and Biology and the British Medical Ultrasound Society.

Delivering more efficient healthcare

How teleoperations is changing radiology

As opportunities for teleoperations rapidly expand within radiology, the concept is being deployed across an array of modalities to deliver more efficient healthcare. A range of speakers covered the topic at ECR 2024. However, challenges remained: radiographers and radiologists were initially slow to accept and adopt the concept, there were cost and technical obstacles, and concerns over a loss of direct contact with patients.

With a range of real-world examples within clinical practice and education, speakers highlighted how teleoperations is making a difference in the way they operate and deliver care to patients. In his introduction to the session, chair Borut Marincek pointed to the World Health Organization definition of telemedicine as 'delivery of health services using digital technologies to overcome distance barriers' and that teleradiology now accounts for at least 50% of telemedicine usage.

A former chairman of the Department of Diagnostic Radiology at Zurich University Hospital, he said recent radiology and health congresses had highlighted the value of teleoperations in solving personnel shortages. But he also pointed to challenges to implementation: a lack of worldwide regulatory standards; costs; and a changing work culture. 'It is paramount that the view of radiographers is taken into consideration when implementing this new technology,' said Marincek, adding that a survey among radiographers on teleoperations is planned.

Cautious approach

Anton Sheahan Quinsten, senior radiographer at University Hospital Essen, Germany, outlined his centre's experiences of remote MRI scanning, noting that 'remote scanning is the most discussed topic among radiographers.' While radiographers are adaptive to new technologies, he conceded an element of caution remains within the profession on the subject.

Remote scanning in the cockpit at University Hospital Essen.

The backdrop is also challenging: increased demand for imaging, an ageing demographic, and a lack of radiographers with vacancies across most hospitals in Germany and an expectation that half of radiographers will retire between 2030 and 2040. In addition, his hospital is spread across a large campus with 50 institutes and clinics and patients meaning time spent having to get to different areas if colleagues need support.

That needed a software solution all scanners remotely with MR operations separated into three processes: patient management, exam management, and quality management.

Given the serious shortage of radiographers in Germany, it was realised that highly-qualified radiographers were not required for patient management (i.e. patient positioning) and staff could be better deployed, leading to a 'cockpit solution' with radiographers in a separate room with screens locked in to all the modalities across the campus. 'Today, our radiographers routinely work from home, with three screens and able to perform three scans simultaneously,' added Quinsten, who during the Covid pandemic became the first person to perform an MRI examination remotely from home. The system is so flexible, he added, that the MRI scanners can be operated from any location at any time.

There were initial 'human and technical' challenges when remote scanning was introduced. Some senior staff resigned, though they have since returned as remote technologists.

His department has now scanned 50,000 patients remotely and since 2023 has deployed a cloud-based solution. 'We have seen that remote scanning has huge potential in the hospital,' he said. 'We can operate all our modalities with fewer radiographer than in the past.'

A technologist in a cockpit centre can share their knowledge, training time for new radiographers has been reduced by half, radiographers can scan from home and experienced older personal who are less mobile can return to their profession.

Quinsten added that on-site radiographers have more time to prepare patients, images can be shared live with other departments and research can be supported. Patients benefit because they do not have to travel for specialist exams and can go to a radiology department closer to home.

Ultrasound teleoperations

Professor Vita Cantisani, Vice-Dean of Medicine and Dentistry at the University of Sapienza in Rome, focused on teleoperations in ultrasound and how it can help remove geographical barriers and resolve staff shortage problems in hospitals. 'Radiologists working in a central hospital can interpret the images obtained in an elevated number of remote patients, thus increasing efficacy, while reducing transport costs,' said Cantisani, who emphasized the importance of specialized training and formal certification and the need for high-end technology.

He concluded: 'Telerobotic ultrasound may successfully answer clinical questions in most cases, allowing patients to receive imaging in their home community and in remote and rural areas where hospitals or imaging centres are not available.' He said it also helps in areas lacking experienced radiologists, while pre-hospital tele-ultrasound may reduce time to diagnosis and improve patient treatment or referral times.

Expanded applications

The session also heard how teleoperations are supporting the military. British Army radiologist Dave Muchena examined the pros and cons of teleradiology in defence medicine, acknowledging it as an 'excellent and cost-effective tool for clinicians in austere environments', but there can be a lack of face-to-face contact and issues of miscommunication.

Dr Ricardo Teresa Ribeiro from the University of Applied Sciences and Arts (Western Switzerland) discussed remote imaging as a means to support radiographer and radiologist education, while Patrizia Cornacchione from the Catholic University of Sacro Cuore highlighted experiences of implementing a televisits system for cancer patients during the Covid-19 pandemic. She said: 'The swift deployment of a telemedicine system, even in the context of a pandemic emergency, is both feasible and well-received by patients. Initial experiences pave the way for expanded telemedicine applications within radiation oncology.' (MN) ■

Anton Sheahan Quinsten

Anton Sheahan Quinsten is senior radiologist at University Hospital Essen and Deputy Chairman of the Radiographers Board in Germany. He studied business informatics and his field of research is Artificial Intelligence in radiography. He is author of the book Information Technology and Artificial Intelligence in Radiology.

Vito Cantisani is Professor of Radiology at the University La Sapienza in Rome with specific interests in multiparametric ultrasound, contrast media and in abdominal and vascular imaging. He is also President-elect of the EFSUMB (European Federation for Ultrasound in Medicine and Biology).

Focus on quality control

Improving radiology department efficiency for hospital inpatients


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Because radiology exams are an integral part of the treatment process for many hospital inpatients, any improvements in efficiency can have a positive ripple effect on routine hospital operations and functionality. Two quality control presentations at the 2023 RSNA Annual Meeting shared the theme of creating representational staff teams to identify bottlenecks involving radiology report turnaround times. Using structured quality improvement methodologies, they developed and tested practical potential solutions, and recorded the results. Their changes, resulting in positive improvements, merit evaluation and testing in hospitals with similar issues.

Should all portable exams ordered for paediatric cardiac intensive care unit (CICU) patients be designated as STAT? At Children's Hospital of Philadelphia, most ICU portable exams were being requested as high priority STAT exams without considering the urgency of their need. This resulted in inefficiencies in processing the radiology findings of highest priority patents to their ordering physicians.

'If everything is STAT, nothing is STAT, because the radiographer team for portable X-ray exams is unable to respond to simultaneous requests,' explained radiology quality assurance technologist Eatrice Y. Hinton, AS RT R. 'Radiographers had to make decisions without clinical input on whom to image first, and this was causing us stress.'

A multidisciplinary team of clinicians and staff members from the radiology department and the CICU was assembled with the goal of reducing the time to take portable exams of high priority patients. The team included physicians, technologists, nurses, a human factors engineer, and a safety and quality specialist, who collectively observed and recorded every step of the process in detail.

They identified three major factors. The radiographers were consistently busy. Priorities were being communicated by telephone and did not always happen or required multiple calls for clarification. Radiographers also did not have access to the patient's electronic medical record (EMR) at the hospital.

Interventions included creating a well-defined clinical criteria list for prioritizing STAT orders and to prevent inappropriate labelling of non-STAT cases. The hospital implemented a new secure chat text messaging system between ordering physicians and CICU radiographers for direct communication. Six months after implementation, turnaround time between order and exam completion was reduced from a median of 24 minutes to 15 minutes.

'The relationship and communications between the CICU teams and radiology teams have improved,' Hinton tells European Hospital. 'Our new process has been implemented in the CICU step-down unit and in the Neonatal Intensive Care Unit. We are currently investigating the clinical criteria needed for implementation in the paediatric ICU and customising it for that portable radiology team's specific clinical needs.'

Reducing turnaround time for routine inpatient neurology MRI reports

The Main Line Health System, serving portions of Philadelphia, Pennsylvania, and its western suburbs, is focused on reducing the length of stay (LOS) of its inpatients to reduce healthcare costs, and has been using its EMR to improve systemwide processes to do so.

'We believe that the Radiology Department has an important role to play in influencing the length of stay,' said radiologist Ashima Lall, MD. 'We had anecdotal evidence that inpatients with neurological diagnosis might have higher length of stay because they were waiting for final imaging results after routine MRI studies.'

So the hospital system created an interdisciplinary professional team to analyze data, troubleshoot, identify barriers, and design a pilot program to resolve them. During its investigation, the team had discovered that the EMR did not alert the radiology department of routine inpatient studies on patients awaiting MRI results to be discharged.

To overcome this, the team developed a "demand signal" in the EMR to identify patients who could be discharged within 24 hours following receipt of MRI imaging results. They expected that this additional EMR functionality would help radiographers and radiologists prioritize routine orders of these inpatients ahead of other routine inpatient studies.

A six-month long pilot study of neurology patients using the demand signal across all four hospitals was launched in March 2022. Discharge results were compared with baseline metrics from May 2020 through May 2021.

With the change, the average time reduction between the order for the MRI and the time it was performed was 9 minutes compared to 17 minutes, and the average time from the MRI to report dictation was 3.1 minutes compared to 4.55 minutes. Impressively, the average time to discharge for this patient group was halved.

This initial pilot data showed that 51% of these demand signal patients were discharged in less than 24 hours and 70% within 48 hours. They were associated with 300 fewer inpatient days and 34.5 observation days compared to the controls.

The team calculated that the cost savings during the pilot study was US $42,649, and US $170,595 if projected to a year. Another benefit is that inpatient beds are becoming available more rapidly for admitted emergency patients. Data is reviewed monthly to ensure that there is no deviation from the process or significant variation from expected projections.

'We continue to use the demand signal in all four hospitals', Lall advises.' In 2023, the Main Line Health System scaled this approach to other imaging modalities like CT and ultrasound.'

She tells European Hospital that after analyzing six months of the data, the demand signal was expanded to CT and ultrasound procedures that were associated with the largest numbers of patients discharged within 48 hours after receiving imaging results back. These selected procedures included imaging studies in both Neuro and Body Imaging.

'Proper selection of imaging studies for demand signal use by an interprofessional team is important and should be data-driven. It may vary at other institutions. This should be emphasized for optimal resource use as it is one of the important drivers influencing the outcome,' cautions Lall. ■

Report: Cynthia E. Keen

AI is key

Lung cancer screening initiatives across Europe

Artificial Intelligence will be a critical component in ensuring a Europe-wide lung cancer screening programme can achieve its potential, according to speakers at a special ECR2024 session.


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Delegates heard that the SOLACE projects (Strengthening the screening of Lung Cancer in Europe) will be supported by AI in terms of workflow, diagnostics, and image and data analysis. Presentations in the session also focused on progress on the initiative in Croatia, France, Hungary and the Czech Republic, in reaching out to under-represented and vulnerable groups.

In her introduction to the session, chair Dr Oyunbileg von Stackelberg from the University Clinic Heidelberg in Germany said that while there was evidence that screening with low-dose CT (LDCT) reduces lung cancer mortality, few countries in Europe had lung cancer screening (LCS) as a national programme in their healthcare systems.

SOLACE, a multi-national project to boost LCS in Europe, includes 33 institutions from 15 countries with ongoing projects and pilot trials.

Reducing mortality by 20%

Radiologist Professor Helmut Prosch from Vienna General Hospital outlined the vision of SOLACE, which is an EU4Health funded initiative within Europe's Beating Cancer Plan, and the challenges it faces.

He said 55% of patients with lung cancer present in the advanced tumour stage, 22% in the regional stage, and 19% with a localised tumour, with 4% unknown. 'Only patients presenting with localised tumour stage have a fairly good five-year survival of 61%, but with more advanced stages, the prognosis is bad,' said Prosch. 'This translates into overall survival of 20.5%. What we are trying to do with LCS is increase the number of patients diagnosed in the localised tumour stage as the smaller the tumour the better the prognosis.' Figures suggest screening with LDCT can reduce lung cancer mortality by 20%, saving a life for every 320 people screened.

Challenges include a lack of European guidelines, limited cost effectiveness data, concerns about reaching groups who would benefit most, and LCS training. 'We know women are under-represented in lung cancer screening, even though they would benefit more from lung cancer screening,' Prosch continued. 'Vulnerable and marginalized communities smoke more and have higher lung cancer incidence but are difficult to reach. The people who would profit the most are under-represented. That is why we have work packages specifically focussing on females and hard-to-reach individuals.'

SOLACE is also working with the European Society of Thoracic Imaging on a unified training system for healthcare professionals involved in LCS.

Digitisation makes workload manageable

As the first EU country with a nationwide LCS programme, Croatia has 20 centres in 14 cities, is fully reimbursed and integrated into the healthcare system, and aims to reduce lung cancer deaths by 20% within 10 years.

Professor Miroslav Samaržija from the Department of Pulmonary Diseases at the Clinical Hospital Center in Zagreb said the programme hopes for a 50% response rate from eligible and high-risk populations and promote an early therapeutic approach. He also emphasized the role of AI. 'It is not possible to perform volume analysis in 20 centres on thousands of participants without the use of AI,' he said. 'Another problem is how to approach high-risk populations and we decided to do that through the GP network. But if you want to connect 2000 GPs with 20 radiology centres and six centres for additional diagnostic procedures and surgery, you need digitalisation.'

For 2024, the plan is for digital integration of LCS with breast and prostate cancer screening and improve data sharing in the SOLACE project.

The session also heard from Professor Marie-Pierre Revel from Cochin Hospital, Université Paris Cité, on the French experience focusing specifically on women through the CASCADE study (Lung Cancer Screening in French women using low-dose CT and Artificial Intelligence for Detection), launched in March 2022. Underlining the importance of a woman-only cohort, she said a key driver was because women are under-represented in LCS studies and that the portion of women among lung cancer patients has increased from 16% in 2000 to 34.6% in 2020 with 41% under the age of 50.

A Hungarian pilot project reached out to deprived populations, while the Czech Republic is focusing on very high-risk participants.

Appeal for more scientific evidence

Biomedical engineer Dr Colin Jacobs outlined the role AI can play in national LCS programmes across Europe in assessing the probability of malignancy, automated detection of lung nodules, and in workflow. 'It determines the type of nodules, measures the size of the nodule and the malignancy probability,' said Jacobs, from Radboud University Medical Center, Nijmegen.

He said there are 17 AI products related to pulmonary nodule detection and/or characterization CE-approved for clinical use in Europe. 'Screening programmes and trials are increasingly using AI, though there is no or little reimbursement for AI support,' said Jacobs. He called for more scientific evidence by continuous monitoring of real-world AI performance in running installations, new research and a need to find good models on how to pay for AI in LCS, as well as creating reference databases for quality control and quality assurance on AI products for LCS.

Pippa Powell from Lungs Europe – a collaboration of the European Respiratory Society and the European Lung Foundation – discussed the participant's perspective and outreach, pointing to a SOLACE stakeholder forum, a lung cancer advisory group, a website (Homepage – SOLACE (europeanlung.org) and social media platforms as well as advice material and newsletters to disseminate information. ■

Report: Mark Nicholls

Colin Jacobs

Research scientist **Dr Colin Jacobs** is from the Diagnostic Image Analysis Group in the Department of Medical Imaging, Radboud University Medical Center, Nijmegen with a specific interest in AI, Chest/Thoracic imaging and computer applications.

Helmut Prosch

Radiologist **Professor Helmut Prosch** is from the Medical University of Vienna and the Department of Biomedical Imaging and Image-guided Therapy at Vienna General Hospital in Austria. A chest/thoracic specialist, his fields of interest include AI, Clinical IT, Hybrid imaging and principles of imaging technology & molecular imaging.

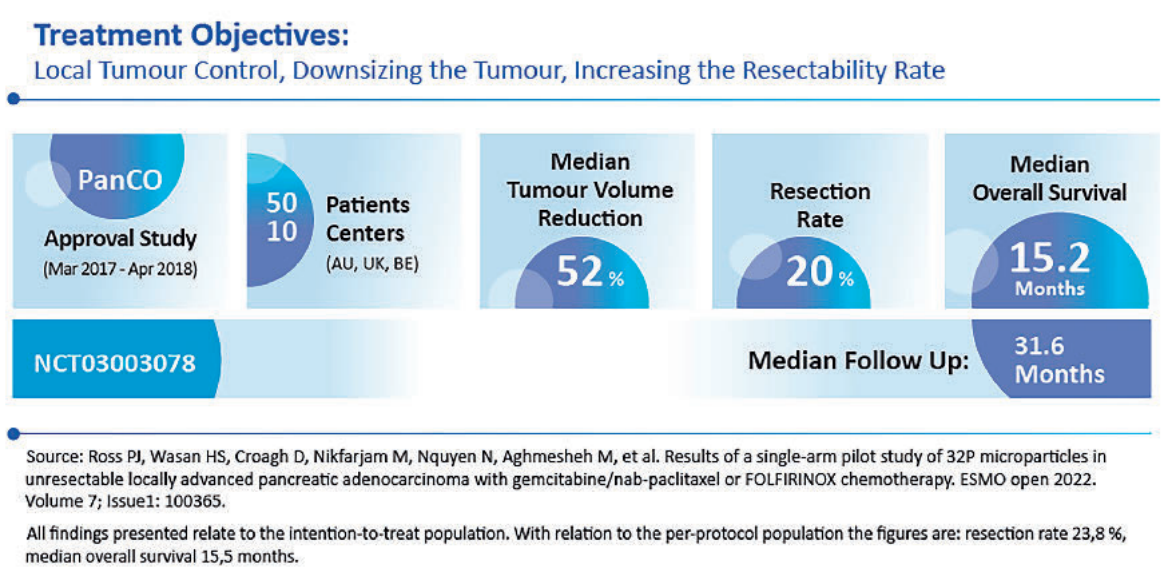
– Advertorial –

Innovative Avenue of Treatment – Internal Radiotherapy for Locally Advanced Unresectable Pancreatic Cancer

In more than one in six patients diagnosed with pancreatic cancer, the tumour is initially diagnosed at a non-metastatic primarily unresectable, *locally advanced* stage (LAPC). For these patients, a new internal radiation procedure, OncoSil™ brachytherapy, may become a treatment option – in Germany, around 858 patients could benefit from this innovation annually.[1]

OncoSil™ is used in addition to systemic gemcitabine-based chemotherapy that has already been initiated. Compared to external beam radiation therapy, the OncoSil™ treatment is intended to deliver approximately double the radioactivity dose to the pancreatic cancer but without considerably increasing side effects and favouring patient quality of life through a single visit to hospital. The main aim of the treatment procedure is local tumour control, potentially downstage the tumour and to enable resection of the tumour ultimately.

OncoSil™ has breakthrough therapy status in the EU, the UK and the USA. OncoSil™ is currently being used in Austria, Australia, Belgium, Greece, Israel, Italy, the Netherlands, New Zealand, Spain, Turkey and the UK.



Source: Ross PJ, Wasan HS, Croagh D, Nikfarjam M, Nquyen N, Aghmesheh M, et al. Results of a single-arm pilot study of 32P microparticles in unresectable locally advanced pancreatic adenocarcinoma with gemcitabine/nab-paclitaxel or FOLFIRINOX chemotherapy. ESMO open 2022. Volume 7; Issue1: 100365.

All findings presented relate to the intention-to-treat population. With relation to the per-protocol population the figures are: resection rate 23,8 %, median overall survival 15,5 months.

High medical demand

Pancreatic adenocarcinoma is considered the cancer with the most unfavourable prognosis and therapeutic options are extremely limited. Incidence and mortality rates are almost identical. The five-year survival rate is around 10 %.[1] EU-wide surveys put the figure at only 7 %[2]. On average, patients fall ill in the middle of their 8th decade of life. The number of cases is rising steadily, due to demographic trends and risk factors such as obesity.[3] Pancreatic carcinomas are usually diagnosed at an advanced stage, due to the often non-existent or unspecific symptoms.

The standard of care for patients with inoperable LAPC has long been systemic chemotherapy, with or without radiotherapy. Surgical removal of the tumour is the only potentially curative treatment. However, this is only possible in 15 to 20 % of patients.[4] Half of all patients have metastases at presentation to healthcare providers, which rules out surgical resection. These patients have a median life expectancy of only around 7 to 11 months.[5] For the vast majority of patients, it is a matter of controlling the disease and maintaining quality of life, without the possibility of a cure.[6,7,8]

Previous study results

OncoSil™ has presented positive results on tolerability, safety and efficacy in six clinical trials. The studies also show that adding OncoSil™ causes a negligible additional safety burden on top of the safety profile of chemotherapy alone.[9]

The PanCO study[9] showed that physicians can achieve local disease control in more than 90 % of patients with unresectable LAPC over 16 weeks and median survival to 15.2 months with OncoSil™ in addition to chemotherapy.[9]

In addition, OncoSil™ (plus chemotherapy) was able to convert previously inoperable tumours into potentially resectable disease in one-in-three patients (33.3 %), and enabled successful surgical resections in almost one-in-four patients (23.8 %) related to per-protocol population (20 % related to intention-to-treat population) with R0 resection margins in 8 out of 10 cases.[2] These are clinically relevant results, as surgical removal of the cancerous tissue can improve the three-year survival rate of an originally inoperable LAPC from 11 to 50 percent.[10]

Handling the OncoSil™ implant

The OncoSil™ treatment involves a team of an oncologist, an abdominal surgeon, an endoscopist and a nuclear medicine physician. The specialist physicians performing the procedure will have previously been instructed in accordance with a training programme provided by OncoSil Medical.

OncoSil™ consists of a large number of tiny microparticles containing the pure beta emitter radioisotope phosphorous-32. The radiating microparticles are implanted directly into the target tumour via injection under endoscopic ultrasound guidance and are designed to provide an absorbed dose of 100 Gy of radiation to the tumour. The device emits 98 % of the radiation within 81 days.[11] The positioning of the microparticles is confirmed using a SPECT-CT Bremsstrahlung scan.[9,11]

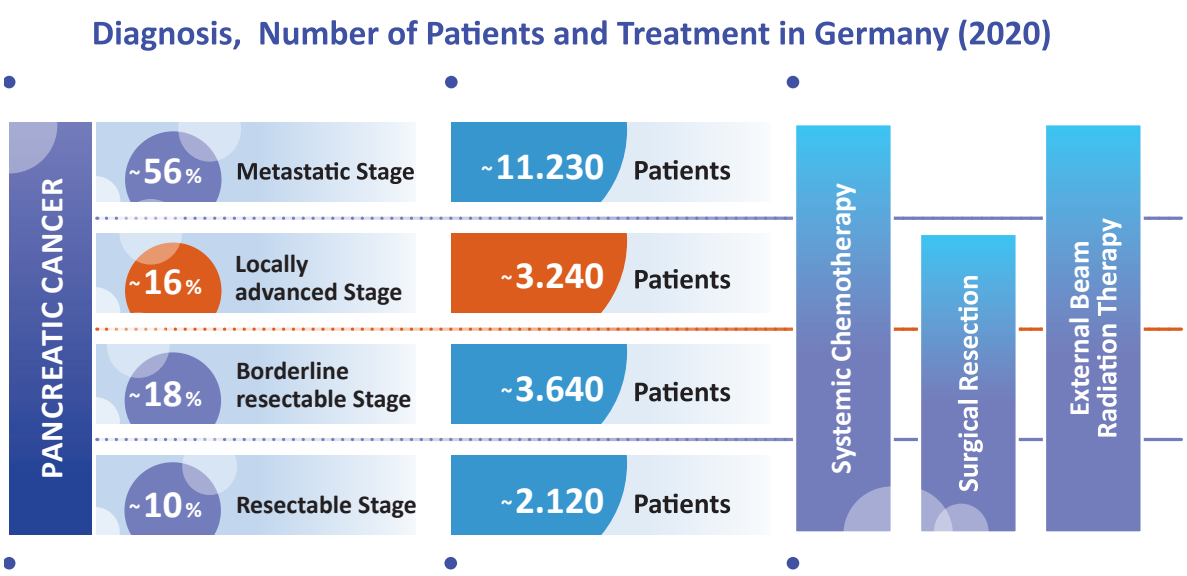
Prof. Dr. med. Volker Heinemann, Director of the Cancer Center – CCC Munich[LMU] – Comprehensive Cancer Center: „There is a great unmet medical need for treatment of locally advanced pancreatic cancer. In this regard, it is important to investigate new avenues of treatment. We certainly hope that brachytherapy may prove to be effective at this stage of disease.“

About OncoSil™

OncoSil Medical is a medical technology company that aims to improve the treatment of patients with pancreatic cancer. The OncoSil™ device consists of microparticles containing Phosphorous-32 (^{32}P) which are delivered by injection directly into a patient's unresectable locally advanced pancreatic cancer tumour under endoscopic ultrasound guidance and in addition to gemcitabine-based chemotherapy.

OncoSil™ was approved on March 30, 2020 as an active, implantable medical device in accordance with Directive 90/385/EEC with CE certificates 718878 and 718879 for the European Economic Area.

[1] *Robert Koch Institute (RKI). Cancer in Germany. Pancreas: 2019–2020. Retrieved 22.04.2024*
[2] *Cancer Research UK. Pancreatic cancer. Survival. https://www.cancerresearchuk.org/about-cancer/pancreatic-cancer/survival. Retrieved September 2020.*
[3] *Robert Koch Institute. Cancer in Germany. Pancreas: 2019–2020.*
[4] *Ducreux M et al. Ann Oncol 2015; 26 (Suppl 5): v56–68.]*
[5] *Robert Koch Institute. Cancer in Germany. Pancreas: 2017–2018.*
[6] *Ducreux M et al. Ann Oncol 2015; 26 (Suppl 5): v56–68.*
[7] *Balaban EP et al. J Clin Oncol 2016; 34: 2654–2668.*
[8] *Cancer Australia. Optimal care pathway for people with pancreatic cancer. 2016. available from www.cancer.org.au/healtb-professionals/optimal-cancer-care-path-ways.html. Accessed July 2020.*
[9] *Ross PJ, Wasan HS, Croagh D, Nikfarjam M, Nguyen N, Aghmesheb M, et al. Results of a single-arm pilot study of 32P microparticles in unresectable locally advanced pancreatic adenocarcinoma with gemcitabine/nab-paclitaxel or FOLFIRINOX chemotherapy. ESMO Open 2022; 7 (1): 100365.*
[10] *Gemenetzis G et al. Ann Surg 2019; 270: 340–347.*
[11] *OncoSil™ System – Instructions for Use*



Source: Robert Koch Institute (RKI). Cancer in Germany. Pancreas: 2019-2020; calculation of the quantity of patients has been conducted by the author on basis of the RKI figures.

Availability of OncoSil™ therapy

The OncoSil™ therapy might become available in Germany as part of a coverage with evidence development (CED) randomised study soon. The federal joint committee (G-BA) is currently discussing the development of the corresponding study design. This CED study would likely feature a comparison of the guideline recommended systemic chemotherapy regimens FOLFIRINOX or gemcitabine plus nanoparticle albumin bound (nab)-paclitaxel versus the addition of OncoSil™ to the systemic chemotherapy regimens.

In parallel, there is growing interest of German hospitals to offer the OncoSil™ treatment for inpatient hospitalisation. In 2022, 25 hospitals were applying for NUB funding, which grew to 36 hospitals in 2023 and in 2024, 84 hospitals finally were granted this entitlement to try to negotiate a supplementary fee to fund the innovative OncoSil™ treatment option with the statutory health insurance companies during the annual hospital budget negotiations.

Challenges and opportunities

Molecular pathology in Europe: in search of standardization

Tackling standardization of molecular pathology at a European level remains a major challenge, according to speakers at the 35th European Congress of Pathology in Dublin. One leading expert warned it would be 'very difficult' to achieve, though the session also heard about potential solutions such as educational steps to consistently train future pathologists at a high and consistent level.

In his presentation, Giorgio Stanta, Professor of Pathology at the University of Trieste, said: 'Everything is changing continuously and we have to follow these changes, but standardization of molecular pathology is not an easy task. We have an urgent need for standardization of the molecular analysis, reproducibility, and exchangeability among European institutions to obtain safety and efficacy of treatment for the patient.

'The necessity of molecular pathology standardization in Europe is related to a more precise diagnosis, prognosis, and prediction of the most suitable therapy and basis of choices of treatment.'

Stanta, an expert in molecular pathology and diagnosis for oncology, outlined the work conducted so far, and challenges still to be overcome. He highlighted how the European Society of Pathology (ESP) Molecular Pathology Working Group is working with the Organisation of European Cancer Institutes (EEIC) towards standardization in heterogeneity, pre-analytical conditions, and clinical evaluation of NGS (next generation sequencing) in breast and colorectal cancer. 'All these projects are very important for clarity,' said Stanta.

Ensuring reproducible results through standardization

A central issue is irreproducibility of clinical research, he pointed out. At the root of this, he pointed out, lie problems of experimental design and interpretation, the complexity of biological and medical information, the pre-analytical condition, highly sophisticated methodologies, intra-tumour heterogeneity, and institutions using similar, but different biomarkers.

Solutions, however, include design and analysis support, medical tumour boards, CEN (European Committee for Standardization) technical specification and ISO standards, internal and external control, and new sampling techniques such as liquid biopsy. Stanta underlined the need for an expert steering committee, suggesting that those driving the European Masters on Molecular Pathology would be best placed for this task.

'We have huge difficulties in standardization because of continuous development of diagnostic molecular pathology, so the standardization must be plastic with continuous corrections,' the expert summarized.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IVDR: No time to waste

Kurt Zatloukal from the Institute of Pathology at the Medical University of Graz discussed reference materials for standardization, guiding delegates through the IVDR (in vitro diagnostic medical devices regulation) and its associated challenges, particularly with calibration of devices and control materials.

Even though the window for implementation has been extended until May 2026 due to the challenges of the Covid-19 pandemic, he warned that time was of the essence as the process could take several years: 'The new regulation gives very specific requirements for a diagnostic assay, not only if it is manufactured by a company and CE marked but also when we do it in our own laboratory.'

IHC biomarkers and LDT – still alive and kicking

Frédérique Penault-Llorca, professor of pathology at the University of Clermont-Ferrand, focused on standardization of the theranostic immunohistochemistry (IHC) through the preanalytical, analytical, and postanalytical phase. She stressed that IHC biomarkers will be around for a while, despite suggestions of their declining importance. Regarding the quality of the tissue and the results, she underlined the need for education and training as well as providing guidelines for scoring, reporting, and monitoring internal quality.

She also examined implementation of new biomarkers safely into clinical practice, emphasizing the need for a sufficient number of cases; testing, training, and monitoring; and standardized reports that are clear for clinicians in line with current guidelines. 'Heterogeneity still exists, despite major progress in the last 20 years,' she said, adding that standardization of the pre-analytical phase is the cornerstone of the subsequent analysis. The use of lab-developed tests (LDTs) will remain important in Europe because of economic issues and equipment constraints, despite IVDR regulation. She also pointed to the value of education and the Molecular Pathology Masters course, outlined in detail by Marius Ilié as the final presentation of the session.

During his lecture on standardization through training, Ilié, Professor of Pathology at the Nice Medical School and co-chair of the congress session, outlined the benefits of the course:

- delivering objective evaluation of knowledge and competences of the new professionals in the field;
- facilitating movement of young molecular pathologists within the EU;
- improved harmonization and standardization of clinical and molecular pathology; and
- providing support for the continuously increasing use of diagnostic, prognostic and predictive biomarkers directly related to treatment choices.

Ilié said of 87 applications, 23 students from 18 countries were admitted on the two-year course. With an array of modules, candidates will be certified molecular pathologists on the course, which will reinforce a standardized approach to molecular pathology. ■

Report: Mark Nicholls

QC at AACC 2023

New risk-based quality control assessment for clinical labs

Juggling the cost of quality control (QC) resources versus the risk of testing error is a balancing act no clinical laboratory manager enjoys. It is an inexact process, itself prone to error, which can impact the operations of hospital labs and independent clinical testing companies. In the current resource-constrained healthcare environment, there is pressure to improve the cost effectiveness of QC programmes and reduce the considerable resources spent on them by clinical labs.

A new method in development to more accurately determine the level of acceptable risk was introduced at the 2023 Association for Diagnostics and Laboratory Medicine (formerly the AACC) Annual Scientific Meeting held in July in Anaheim, California, USA. The Precision QC (PQC) model offers more precision than the one-size-fits-all models currently in use in many clinical hospital laboratories, according to its developers from the University of Utah in Salt Lake City. It is dynamic and flexible, and can be adapted to a wide range of QC monitoring methods, QC behaviours, and clinical scenarios.

A watchful eye on systemic and measurement errors

In spite of best efforts, errors in laboratory test results occur, caused by systemic error, measurement error, or both. This results in false positive (FP) and false negative (FN) events. FP events incur costs associated with troubleshooting to identify their cause, reagent use, downtime, repeat testing, and recalibration. Identifying the reason for a FN event can stretch lab financial and staff resources, hinder lab operations, and potentially can have significant health consequences to a patient.

QC systems are designed to detect when systemic errors start occurring. How stringently parameters are set has a direct impact on the number of FPs that occur. Assessing risk of error is important, because QC settings that are too stringent may be just as problematic for a lab as those that are too lax.

'We view an assay as a dynamic system that evolves from state to state over time. It will shift and the question that needs to determine risk is frequently of shift and shift size distribution,' says Robert Schmidt, MD, PhD, formerly a professor of pathology and principal investigator of the Utah team.

The expert compared these shifts in laboratory equipment to change in performance in other equipment, such as cars or bikes. Only in the former, there are countless components that are subject to change over time that can manifest itself as a change in performance, he explains.

Assessing the "problem potential" of lab tests

Incorporating risk can be beneficial for a QC programme. Some assays are reliable, robust, and stable, with few errors. For others, measurement error will not result in immediate clinical harm, or, the results of the tests being performed have a low impact on clinical outcome if an error occurs. At the other extreme are "problem" assays, with known performance volatility, or whose results have critical cut points, and which have a high cost when failures occur.

The researchers define risk as an event equal to the probability and cost of the event. It's also important to factor in intuition, ideally without introducing bias from prior experienced events.

'The PQC model views an assay as a dynamic system that evolves through various states over time, and is not necessarily a single shift that remains constant until discovered,' explains Joseph W. Rudolf, MD, an assistant professor and medical director in the Clinical Pathology Division's Automated Core Lab. 'The system starts in the In Control (IC) state and at some point moves to an out of control (OCC) where it remains, until the QC monitoring system raises a detection signal, at which it is restored to the IC state. The overall behaviour of the system is determined by the proportion of time spent in each state (a level of system systematic error), which determines the risk. One of the key features of the PQC model is that it explicitly includes the shift probability, which links the rates of FP and FN events. This feature makes it possible to construct trade-off curves between FP risk and FN risk, which characterise the performance of the QC monitoring system.'

'This model will help you quantitatively assess if QC resources spent on each assay to maintain its testing accuracy is appropriate, too little, or excessive,' Schmidt and Rudolf advise. 'By mixing and matching parameters relating to different assays, you will be able to clearly visualize the results and make informed decisions.' ■

Report: Cynthia E. Keen

Overheard at Semi-Live 2024

Exchanging insights on advances in urological surgery

The sixth Semi-Live event took place at University Hospital Heidelberg, the very same location it was initially held in 2015. The host, Professor Dr. Markus Hohenfellner, Chairman of the Department of Urology at University Hospital Heidelberg, told the audience that the idea for the event 'was born by dreaming'. It came to life after he had secured the support of Dr. Sybill Storz, at the time Chief Executive of Karl Storz, a medical equipment manufacturer of endoscopy instruments, and Patron to the Royal College of Surgeons in England.

Since its inauguration, Semi-Live has developed into an internationally renowned conference format that serves as a platform for exchanging experiences amongst urologists in the form of presentations, video footage from surgeries or live transmissions from operating theatres. For Hohenfellner, surgical techniques constitute the cornerstone of urology. They are deployed for oncological operations, reconstruction, benign prostatic hyperplasia (BPH), benign prostatic obstruction (BPO), kidney transplantation, and kidney stone removal, to name but a few pathologies.

Surgeons can choose from a variety of surgical approaches including open surgery, laparoscopy, shock waves as well as robotic, endourological and microscopic procedures. Since a multitude of urological indications can be treated with various procedures that lead to comparable outcomes, an event where urologists from across the globe share their experiences with diverse treatment options is especially valuable and relevant. Discussions at Semi-Live made it evident that there are not only individual preferences in surgical approaches, but also national preferences.

The advancement of urology

The conference looked at how surgical approaches have evolved in the last few decades driven by technical advances in the ongoing quest for precision and excellence in patient care. Here are exemplary insights from selected speakers:

Dr. Viktoria Schütz, Department of Urology, University Hospital Heidelberg, Germany, dedicated her presentation to the evolution of salvage prostatectomy. She pointed out that advances in surgical techniques led to an evolution in salvage prostatectomy that resulted in reduced peri-operative and post-operative morbidity. However, Schütz made clear that salvage surgery is more demanding and is associated with higher risks to other organs, especially the rectum.

Prof. Dr. Lukas Lusardi, Chairman Department of Urology, Paracelsus Medical University Hospital, Salzburg, Austria, compared transurethral resection of the prostate (TURP) to minimal invasive alternatives in his presentation. Compared to newer bladder pain symptoms (BPS) therapies, TURP can look back on decades of documentation. The reintervention rate after TURP due to a BPS recurrence after 8 to 22 years lies between 1.9% and 7.4% and 79% of patients are still satisfied with the results of the TURP intervention more than 15 years later.

Lusardi explored minimal invasive alternatives to TURP, including Urolift, iTind Prostatic Artery Embolization (PAE) and Rezum. PAE is less effective than TURP at improving symptoms and urodynamic parameters such as flow rate and needs a longer procedural time but scores higher than TURF with regards to blood loss, catheterisation and hospitalisation time. Nevertheless, it can be performed under local anaesthesia.

No need for nostalgia

Associate Prof. Dr. Jörn H. Witt, Head of Robotic Urology, Goldstadt Clinic, Pforzheim, Germany, discussed newer surgical approaches to what he referred to as the "open days": these were characterized by high blood loss, up to six catheters, stents or drains, lengthy hospital stays and catheterization, accompanied by high stricture and complication rates in addition to a prolonged general and functional recovery period. He reviewed the performance of open surgery and minimal invasive approaches – endoscopic, laparoscopy and robot-assisted surgery – when measured against 3D vision, degrees of freedom, option for complex movements and the spectrum of magnification.

Robot-assisted surgery clearly outperformed all other approaches in terms of magnification rate (10–20 times). In his view, robot-assisted surgery is in many aspects closer to open surgery than to laparoscopy. Witt advised that in the end, the oncological and functional results of surgery depend on an individual's anatomical understanding, tissue handling and experience, in addition to a surgeon's talent, training, reflection and retraining and team factors including communication skills. He ended with an appeal to practice critical thinking and keep learning: 'A lot of things we can still do better.'

Dr. Karin Lehrich, Urological Laser Center, Vivantes Auguste-Viktoria-Hospital, Berlin, Germany, demonstrated how to master the Holmium Laser Enucleation of the Prostate (HoLEP) technique. Starting with endourological experience and knowledge of anatomy and physical laser characteristics, she delved into the importance of teaching and coaching, including the attendance of workshops and webinars, visiting excellence centres and having a mentor as well as supervision. Lehrich also recommended simulator and hand-to-hand training, as well as studying video clips and YouTube for mastering laser physics. She explained the intricacies of laser-tissue interaction, urging surgeons to understand the ideal distance between the laser fiber tip and the tissue for optimal outcomes.

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Regardless of the chosen approach, Hohenfellner urged surgeons to keep self-assessment as a fixed part of their daily routine: 'We need to establish if we are fit to do what we want to do', he said.

Telesurgery in action

True to its name, Semi-Live featured several live demonstrations of telesurgery. In one case, Prof. Xu Zhang, head of the urology department at the People's Liberation Army General Hospital, Beijing, China, performed a radical prostatectomy.

Zhang, who has spearheaded robot-assisted laparoscopic surgery in China, has also pioneered remote and intelligent surgery. In the televised live remote prostatectomy, he used edge robots with a resolution of 1080 pixels to operate on a patient located in Sanya, a Chinese city 3,000 kilometres south of Beijing. China Telecom provided an Optical Transport Network (OTN) to enable the high-speed data transmission, whereby the surgery was performed using a dedicated line with a bandwidth of 60 MHz. The delay of 117 milliseconds remained unnoticed by the surgeon, however, a delay larger than 200 milliseconds would be noticeable. A doctor of Zhan's team who was present in the audience in Heidelberg explained that there was also a surgical team standing by at the patient's side in Sanya so that they could carry on with the operation in case transmission problems would occur.

A glimpse into the future of surgery

Will robots take over in the operation theatre? When Hohenfellner turned to ChatGPT for an answer, he was told by the chatbot that it was quite conceivable that AI-based "large motor models" could be developed in the future. These might perform fine motor tasks, with a focus on the physical interaction and manipulation of objects by robots. Possible applications of such models could be in surgery or other areas where precision is critical. It will be left to future Semi-Live events to explore this topic further. ■

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Compared to laparoscopy

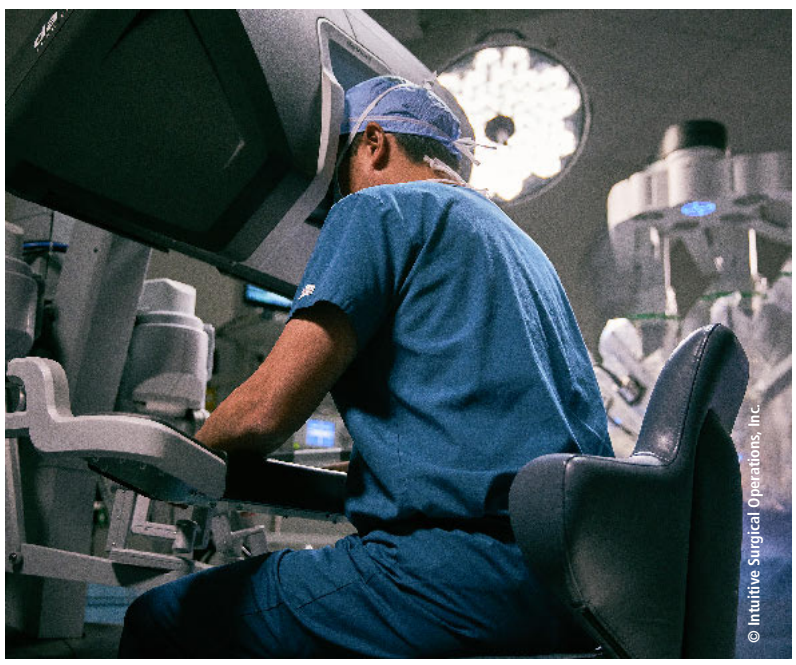
Robotic surgery improves colorectal surgery outcomes

When colorectal surgery was first performed with robotic assistance in 2014, the procedure was questioned about safety, efficacy, and outcomes. Today it is an established option. Well-trained surgeons use robotic surgical systems confidently. Numerous clinical studies have verified its intraoperative benefits for patients and surgeons alike, as well as very positive outcomes for patients.

Findings from recent clinical studies conducted in Europe and the United States comparing the outcomes of patients having robotic colorectal surgery with those having conventional laparoscopic surgery and the surgical costs reinforce that the use of robotic surgery produces improved outcomes for patients during both with respect to the surgery and recovery. Surgeons also benefit.

However, robotic surgery takes about 20-30% more time in the operating room to perform and is much costlier than conventional laparoscopy. However, the combination of increased use of the robotic platform for surgeries will reduce per procedure cost, and increasingly sophisticated integrated AI technology integrated into it is expected to reduce operative time. These factors would lower barriers to adoption and implementation by hospitals and motivate surgeons to invest in the lengthy and extensive training program to become skilled in its use.

Robotic surgery systems offer the advantages of an immersive 3D magnification to enhance depth perception, a stable camera platform, articulating wrists with seven degrees of freedom, bimanual improved dexterity and instrument control, and improved ergonomics. A robotic system provides easier access to narrow places, enables more precise and complex movements, and facilitates the performance of complex procedures.



Colorectal cancer is the third most common cancer in the world. Over 1.9 million new cases were estimated in 2020 and 2022, based on the GLOBOCAN database of 185 countries.[1] Researchers estimate an increase to 3.2 million new cases by 2040.[2]

More "textbook outcomes"

Researchers at UT Southwestern Medical Center in Dallas, Texas, US, evaluated the perioperative outcomes of patients having right colectomy (RC), left colectomy (LC), and rectal cancer surgeries based on "textbook outcomes", criteria that includes the absence of 30-day complications, a length of stay (LOS) less than five days, and hospital readmission. They matched rectal surgery patients having rectal surgery 1:1 with respect to having laparoscopic versus robotic surgery. Patients having right or left colectomies were matched 2:1. A total of 26,133 patients from a cohort of 53,209 were selected from a national database.

Principal investigator Patricio M. Polanco, MD, and colleagues compared baseline preoperative characteristics, intraoperative outcomes (such as number of lymph nodes harvested, unplanned conversion to open surgery, and operative time), and postoperative outcomes. The latter included textbook outcome, anastomotic leak, postoperative ileus (the inability to contract), LOS five days and longer, readmissions within 30 days, complications, and mortality.

They reported in the World Journal of Surgical Oncology[3] that robotic surgery was associated with a higher rate of all "textbook outcomes" compared to laparoscopy in RC and LC, at 71% versus 64% respectively in RC, and 75% versus 68% in LC. Robotic resection also had a lower conversion rate to open surgery. Overall complication rates, anastomotic leaks, the number of bleeding transfusion occurrences within 72 hours, major morbidity, and 30-day mortality were comparable.

Both approaches produced near comparable results for rectal surgery, although robotic resection had a significantly lower conversion rate of 3.9% compared to 10.4% for laparoscopic surgery. However, robotic surgery had a higher rate of major morbidity, postoperative ileus, and anastomotic leak.

Robotic surgery took a much longer time to perform for all procedures, with a mean operative time of 225 minutes compared to 177 minutes in laparoscopy.

A small comparative study of 83 colorectal cancer patients having 46 robotic and 37 laparoscopic resections performed at University Medical Centre Ljubljana in Slovenia showed that none of the patients having robotic surgery required any transfusions or conversion to open surgery, compared to five (13.5%) and six (16.2%) patients respectively in the laparoscopy group. Patients in the laparoscopy group also stayed in the hospital one additional day. Complication rates were comparable. According to first author Jan Grosek MD, and colleagues, this study was unique because two highly experienced surgeons performed all the surgeries using both surgical techniques.[4]

Comparing clinical and financial outcomes

Rectal cancer represents 28% to 35% of all colorectal cancer cases. The surgery – radical resection by sphincter-preserving rectal resection with total mesorectal excision (TME) – requires a meticulous surgical technique with little margin of error. The instruments used in laparoscopic surgery have inherent limitations in TME, requiring a higher intraoperative conversion rate to open surgery than RC and LC.

Researchers at Charité University Medicine Berlin, Germany, a referral centre for colorectal surgery, hypothesized that robotic-assisted surgery would reduce the open surgery conversion rate, shorten LOS, and improve the quality of TME. First author Jasper Max Gebhardt, MD, and colleagues retrospectively analyzed data from 125 consecutive patients, 66 undergoing robotic surgery. Patients had been selected for either procedure based on equipment (Da Vinci X Surgical System, Intuitive Surgical, Mountain View, California) availability.

The study's primary endpoint focused on the rate of 30-day postoperative complications, as well as operative time, rate of conversion to open surgery, LOS, and quality of TME. 13.6% of robotic surgery cohort experienced severe postoperative complications, compared to 30.5% of the laparoscopic surgery cohort, more than double the amount. Intraoperative adverse events were comparable, but more laparoscopic patients had follow-up surgery, at 22% versus 13% for the robotic group.[5]

As expected, operative time was longer, with robotic surgery taking a median 379 minutes versus 302 minutes for laparoscopic surgery. Surgical costs were also higher, a median of 17663 euros versus 14,883 euros.

A trade-off exists: perform a substantially more expensive colorectal cancer surgery or subject a patient to a much higher level of severe complications? Further studies are needed to compare surgical cost plus the cost to treat severe post-operative complications to make this an equitable comparison. To date, none have been published.

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