



Notable medical AI in China

Impressive advances reported at Intelligent Health 2019

Report: Cornelia Wels-Maug

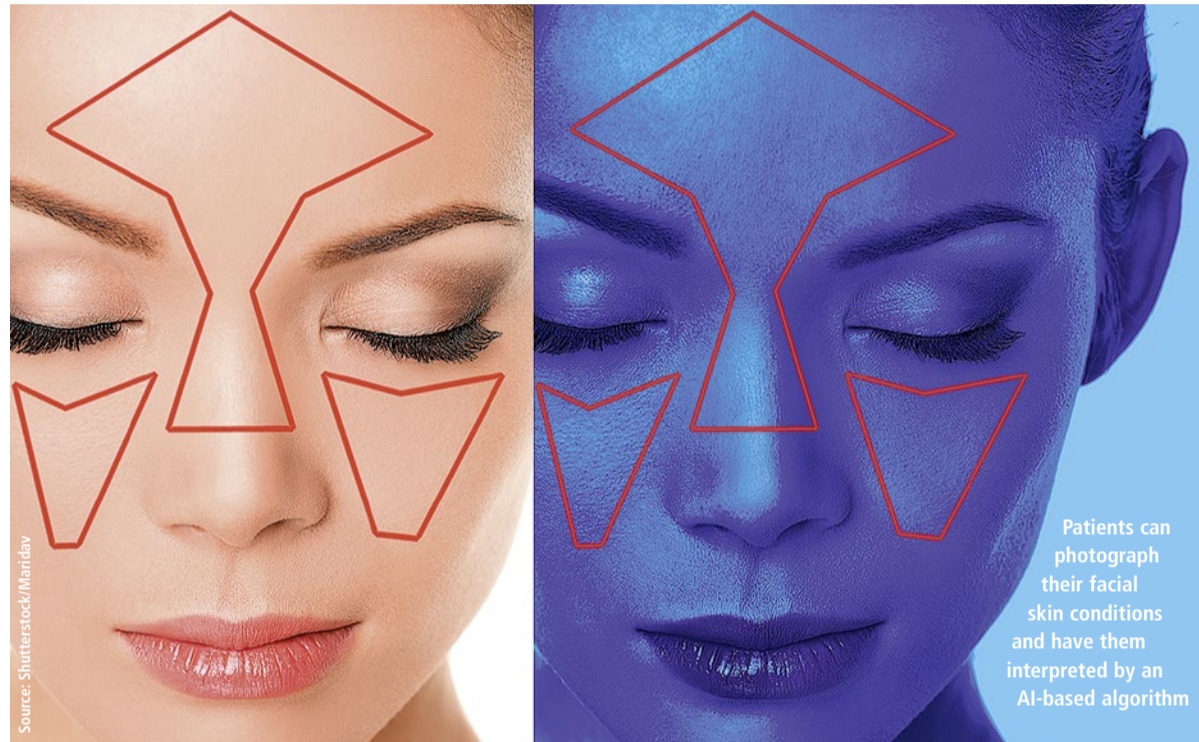
September: Basel, Switzerland: 'Intelligent Health 2019', a conference dedicated to artificial intelligence (AI) in medicine, underlined the growing interest by the rising number of attendees – 1,400 in 2018, its first year, to 2,027 this year.

With examples of AI use from around the world, the common thread throughout was how AI can serve humankind by enabling better understanding of patients and offering the means to improve productivity and effectiveness. It has the potential to render the dream of precision medicine a reality, according to one speaker proclaiming the potential benefits.

Sizable medical use of AI

The extent to which AI is already used varies substantially between countries. The Xiangya Hospital, Central South University, Changsha, shows the largest medical use of AI and smart care in China, according to Professor Weihong Huang, who works in the hospital's Department of Dermatology, and for the Mobile Health Ministry of Education – China Mobile.

Founded in 1906, the 3,500-bed Xiangya Hospital has a catchment population of 100 million people and serves about three million outpatients and 130,000 in-patients annually. It belongs to a group of 44 comprehensive public hospitals in China that are directly administered by the Ministry of Health. What also sets this hospital apart is that it is 'the first and only ministry key laboratory in health information technology of China and specialises in mHealth, big data, AI and IoT', Huang explains. Based on its profound database of medical information, the hospital has been deploying several AI-use cases



Source: Shutterstock/Manitay

Patients can photograph their facial skin conditions and have them interpreted by an AI-based algorithm

to determine the effectiveness of artificial intelligence.

AI-based decision support – on par with doctors

Given the extent of patient data collected over recent years, Xiangya Hospital oversees a substantial database of medical information that spans well over a decade in most cases: the compilation of medical orders (20 bn) and drug information (30 bn) has been going on for more than 15 years; lab results (+400 mil) and examinations (+250 mil) have been collected for more than 10 years; medical records (1.8 mil) for seven years and imaging reports for more than six years respectively. This trove of information has prompted the hospital to look at ways to use it for AI-based applications in an attempt to offer 'smart' services:

'We need new business that allows for more intelligent, accessible and affordable care', says Huang.

In China, skin diseases are a widespread burden, with high rates of allergic skin reactions and signifi-



ACEM

Hall 10
B60

cant mortality rates due to skin cancer. The dermatology department of Xiangya Hospital organises the largest national biological sample bank for rosacea, lupus and skin cancer, Huang explains. It also possesses China's largest clinical image dataset of skin diseases.

Skin care based on image recognition

The image library is the key enabler for Xiangya's so-called smart care platform, which contains one million dermatopathology pictures, a standardised skin disease library with 400,000 images, and a tagged picture repository of 20,000 images

Continued on page 2

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The first dermatology Internet hospital in China using AI for improved diagnosis

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The brain sits at the PC – artificial intelligence in medical care

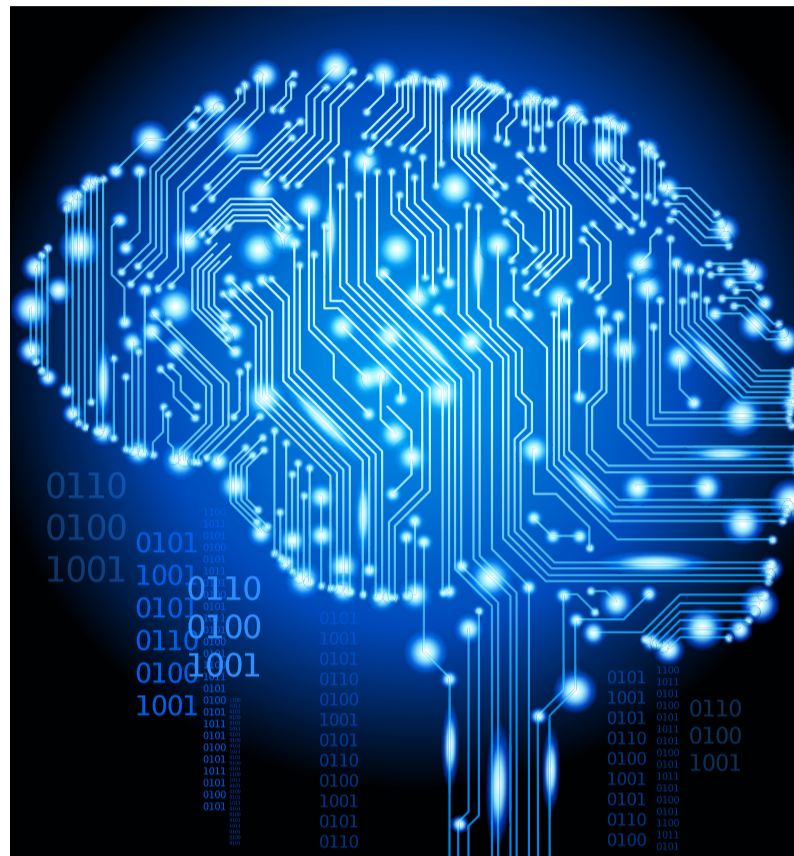
Report: Cornelia Wels-Maug

AI has made headlines for years, including in such scientific publications as 'Nature', an indication of its high relevance, according to Dr Tobias Müller, Head of Digital Transformation at the Rhön-Klinikum AG. However, he also delivers a note of caution because studies are often aimed at demonstrating the equivalence of AI-based diagnoses with those made by doctors. 'You have to read these studies very carefully,' Müller advises.

Some certified AI-algorithms for the medical sector can be bought already. According to Müller's research, 34 of these algorithms are currently available, with many suppliers based in the USA and Israel. The majority, says Müller, are applications for the fields of radiology and neuro-radiology. screen.'

Rapid growth of medical knowledge

Even now, AI is a great help for decision support. The rapid growth of medical knowledge makes it impossible for individual physicians to keep completely up-to-date with the current state of research in their respective medical disciplines as specialist medical knowledge doubles exponentially: Whilst in 1950 it would have taken 50 years for the volume of knowledge to double, it is estimated that, by the year 2020, this



period will have shortened to just three months.

AI: a 'must' in diagnosis of rare diseases

Rare diseases diagnoses present doctors with additional challenges, especially as the short window of

time spent with patients often makes it impossible to document all their symptoms. 'AI is already a must-have for rare diseases today,' reports Schäfer, who relies on tools based on AI-algorithms such as those supplied by Ada Health or Isabel Healthcare. 'We need them in clinical routine

because they deliver important diagnostic assistance. They facilitate the recording of numerous symptoms without much effort,' he says, and therefore help to improve the diagnostic process significantly.

But AI not only leads to improved diagnoses; it also creates new types of conflicts between ethical and legal considerations and the use of technology, all of which need to be resolved. AI always requires users to think and to scrutinise the suggestions made by AI-based tools with their medical knowledge, as, says Schäfer: 'The brain sits in front of the screen.'

AI and tumour detection

Dr Felix Nensa, radiologist and senior consultant at Essen University Hospital, heads a working group on artificial intelligence: "Big Data" does not automatically mean 'Big Value', explains Nensa. 'This only applies when we can analyse the data. We need AI to close this gap. Much data from radiological images is not yet being utilised,' he points out. Nensa and his team are developing an AI application which, based on images of a primary tumour, can determine if it has already spread. This would not only do away with the need for a biopsy but would also shorten the time required for diagnosis, making it possible to start treatment faster. 'This virtual technology works well in parts, although the results are based

on just a small study. But the potential is large,' says Nensa.

The future of artificial intelligence

Experts expect that the use of AI in medical practice will develop from the current rule-based to data-based and even feedback-based applications. We will also see a change from only slightly automated to highly automated applications or proactive interventions respectively. In the medium term, current AI applications, such as prognostic scores, dose calculations or order sets will be complemented by data-based applications, such as context-based information, multifactorial disease risk prediction or automated triage. Autonomous diagnosis, however, is still in the distant future. It would require an algorithm to incorporate feedback, to continuously evolve and adapt and to design future scenarios. 'We are still a long way off this,' says Müller.

On the way there, many questions must still be answered, such as 'How can we obtain sufficient numbers of data training sets?' 'How can we assure sufficient data quality?' 'Who accepts responsibility for errors with algorithms?'

It is, however, undisputed that future AI applications will have to abide by the dogma that medicine must not do damage but must be safe and effective.

Advanced LED optics technology

Highly controllable medical lamps

Based on the next generation LED technology, ACEM, of Bologna, Italy, reports that one of the firm's newly launched lamps ensures cold light, long life and low energy consumption. 'Starled3 NX grants a homogeneous and shadow-less light thanks to its special LED optics, created by the company, that direct light beams according to needs,' Acem reports. 'The visual area is perfectly illuminated assuring both excellent visual comfort and working conditions. Its next generation LEDs produce an unparalleled quality of light with a colour temperature (CCT) of 4.500 °K and a colour rendering index (CRI) of 95.

'The lamp offers a light intensity of 130.000 lux (160.000 optional) with a low energy consumption of 69W.

'The life cycle of its LEDs is about 50.000 hours,' the company adds. 'Starled3 NX is composed by three reflectors that produce a well-blended and intense cone of light focusable through the automatic adjustment of the light spot diameter.

'The slim, practical and compact design makes it perfect for several

uses. The lamp is ergonomic, easy to move and to position and suitable for the laminar flows of the operating room.'

Functions

The lamp has an easy-to-clean shape and material, and the handle is removable for sterilisation.

The functions listed here are controlled via an I-Sense control panel:

- Light intensity adjustment
- DoF - Depth of Field - for a deep light
- Endo - Light for endoscopy ideal for minimal-invasive surgery
- Size - Light spot diameter adjustment to focus the operating area
- Sync - Function (optional) useful to synchronise controls of the combined lamps: Starled3 NX double (twin dome configuration) and Starled3 NX together with Starled5 NX – which comes in the following mounted versions: ceiling, wall, trolley (ABPS battery on demand).

A rechargeable battery aids mobility

ABPS, a rechargeable battery-powered system made by Acem, measures 550 x 340 x 240 mm and fits into the trolley base. The battery's electronic control panel manages fundamental parameters, such as residual charge, type of power supply, recharge status and electrical power supply presence, and an automatic switch from electric power supply to battery power so that the Starled3 NX can be used as a high-performance mobile unit, the manufacturer points out.

respectively.

Based on those images, the dermatology department created a dataset containing 2,656 facial images showing six common skin diseases (seborrheic keratosis, actinic keratosis, rosacea, lupus erythematosus, basal cell carcinoma and squamous cell carcinoma) and tested the ability of convolutional neural networks to diagnose those six skin diseases accurately.

At a later stage, patients were asked to photograph their facial skin conditions with a mobile device. Subsequently, these were interpreted by an AI-based algorithm. 'The results are comparable with those from dermatologists', Huang says. In the case of psoriasis, he explains, the algorithm even performed slightly better than a group of 25 dermatologists when interpreting a sample of 100 images.

There is an insufficient number of dermatologists in the region so, backed by these findings, in November 2018 Xiangya Hospital resorted to launch the first dermatology Internet hospital licensed to operate online in China. Furthermore, Xiangya is collaborating with over 100 other hospitals across 30 provinces and has established the first national skin cancer collaborative network to enable a faster access to diagnosis and subsequent treatment for patients.

More AI-supported services

Xiangya Hospital also deploys AI for other cases to make better use of

limited resources via automation. This includes an interactive app that enables patients to upload their medical history, including pictures, ahead of an appointment, to free up time for the actual diagnosis when visiting a clinician. Another example is the so-called 'smart cervical cancer screening' programme, which assists in examining 60 million women annually by reducing the time it takes to evaluate the involved pap test slices. 'We want to bring down the time for evaluation of the slides from currently 60 seconds to 50 and even 45 seconds', Huang explains. 'Currently, we review 200 slices per day; this programme will help us to increase this to 300 slices per day in the future.'

Health IoT – the future

Huang is convinced that the future of healthcare will be data-based. Hence, he stresses the importance of IoT for generating a broader data base of medical information and outlines his vision of health IoT. 'H.IoT will be the new thing. We want to use health data more effectively to enable smarter care. For this, we need to establish a consistent management and quality control of health-related data from inside and outside the hospital. We even need to collect data that is small, dirty and incomplete', Huang postulates. 'Data is good. The future will be a smart home', he confirms, urging his audience: 'Don't be lazy'.

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More standardisation for POCT systems

POCT needs validation and assurance processes

Report: Anja Behringer

Point-of-care testing (POCT) is complex and its development continues due to digitisation in healthcare and increasing international partnerships among the healthcare actors.

In a hospital, a number of factors need consideration to fully exploit the potential of bedside testing. POCT instruments and analysis methods must be thoroughly validated and quality assurance processes be in place. Training is crucial but, since this puts an additional burden on staff, procedures should be communicated appropriately.

To manage all these aspects efficiently, close cooperation with the central lab is of utmost importance, says Professor Peter B Luppa, Director of the Central Laboratory at the Institute of Clinical Chemistry and Pathobiochemistry at Klinikum rechts der Isar in Munich's technical university. 'Our POCT working group recommends establishing a coordination office to ensure patient safety in the POCT/central lab interconnection and to guarantee best possible hospital care,' he adds.

The coordinator can contribute significantly to an improvement of quality assurance. But Luppa also takes manufacturers to task: it is their duty to provide instruments that comply with quality assurance standards laid down in the German Medical Association's guidelines on



the quality assurance in medical laboratory tests.

In intensive and trauma care there are three lab parameters categories. First, mandatory parameters which directly influence therapy and have to be made available within 60 minutes. These are obvious POCT parameters.

Secondly, there are parameters that are not crucial to avoid an apparent life threatening event but which nevertheless influence diagnosis and/or therapy. According to international

standards patients should stay in the A&E department a maximum of four hours. Thus the relevant parameters have to be ascertained within this time period.

Third, there are parameters that do not influence diagnosis and/or therapy but which have to be made available in an emergency to maintain A&E workflow. POCT should be limited to the few crucial parameters and be organised in cooperation with the central lab, which acts as a satellite lab for the emergency room.

Several acute health conditions need immediate laboratory results, e.g. coagulation data in case of a stroke, or cardiac markers when a myocardial infarction is suspected. POCT only rarely provides the same quality of results as the tests done in the central lab, thus there is a trade-off between speed on the one hand and sensitivity and precision on the other.

Moreover, intensive and trauma care departments are open 24/7, which means that at certain times



Professor Peter B Luppa is head of the Central Laboratory and Blood Bank at the Rechts der Isar Hospital in Munich's Technical University. His main scientific interest lies in the regulation of steroid metabolism and biosensors, aiming to develop improved analytical-diagnostic procedures for autoimmune diseases. From this, POCT in the hospital developed as a further focus. He has published more than 125 contributions in international journals and is a co-editor of the first German specialist book on point-of-care Testing (now in its 3rd edition).

non-critical parameters must be determined with bedside testing.

Going forward, POCT systems need further standardisation in terms of both methods and quality management and the results yielded by POCT should be comparable to lab results.

The central lab can play a crucial role in supporting clinical staff and designing methods to compare and correctly interpret POCT and lab results. 'The instruments have to be networked with the POCT coordinator – a fact that has been widely recognised,' Luppa points out.

In the future, he is convinced, 'the enormous potential for the detection of infectious diseases in emerging economies and developing countries will be explored. Detection techniques are revolutionary. Since, in these countries, central labs are few and far between, POCT is the way to go. This is a further reason why POCT quality must be as good as the quality of lab tests.'



Weihong Huang holds a B.Eng. degree in automation, an M.Eng. degree in pattern recognition & smart control from Southeast University and a Ph.D. in computer science from Nanjing University, China.

He was a Postdoctoral Research Fellow with CNRS University Lyon 1 in France, a lecturer in the Department of Computer Science, University of Hull, UK, and a Senior Lecturer at the School of Computer and Information Systems, Kingston University, UK. In 2016, he became a professor and Depute Director of the Mobile Health Ministry of Education-China Mobile Joint Laboratory, Xiangya Hospital, Central South University. His research includes mobile health, AI in healthcare, cognitive computing for healthcare, semantic multimedia computing, and knowledge graph applications.

Huang is a Committee Member of the China Hospital Information Management Association, a Standing Committee Member of the Medical and Health Big Data Evaluation and Assurance Board of the Chinese Health Information and Big Data Association.

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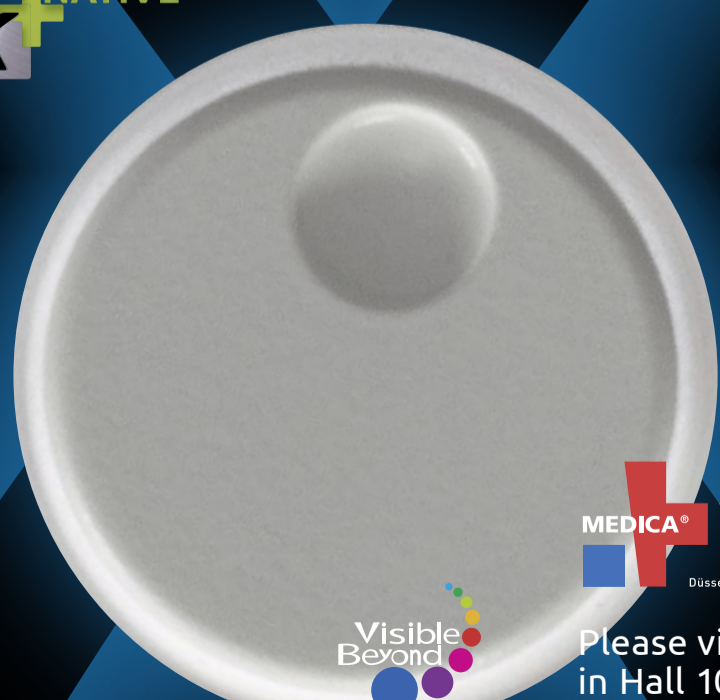
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WHO: 'Refugees do not bring diseases to western shores'

Detecting migrant health risks

The migrant population is fast growing and heterogeneous. Experts at a session held during the European Congress of Radiology (ECR 2019) concluded that radiologists can play a key role in detecting and differentiating related diseases.

Migration is a growing phenomenon and has an impact on health, according to Jozef Bartovic from the World Health Organisation (WHO) in Copenhagen, Denmark. 'We've seen a huge increase in migration over the last few decades, and about 10% of global population today are international migrants. There is a huge heterogeneity of resources, backgrounds, exposure to risks, which are all important to consider in healthcare. Refugees are just 7% of all migrants,' he said.

Key migration factors can lead to health problems before, during and after migration. War impacts on mental health before and after migration. Violence during migration, for instance smuggling, burns or drowning, has consequences on a migrant's health. Discrimination and low levels of integration in the host country can also trigger health problems.

The WHO refugees and migrants' health in Europe report states: Migrants do not bring diseases with them to their country of destination. 'Refugees and migrants are generally

in good health, but can be at risk of falling ill during the transit period and in the receiving countries, due to poor living conditions and adjustment to their new lifestyle,' Bartovic pointed out.

Considering the incubation period of most bacterial and viral infections, most migrants will be either cured or dead by the time they arrive in the destination country. Living in a refugee camp, for instance, can provoke a number of diseases that can be fatal and take up considerable healthcare funds if untreated. Very early detection and correct treatment of diseases is key.

'The links between migration and radiology are worth exploring, especially regarding access to services, legal barriers, health service capacity and continuity of care,' he said.

TB or not TB

The most common migration diseases relevant to radiology are pulmonary and extrapulmonary tuberculosis (TB), according to Tim Weber, senior physician at the Institute of Diagnostic and Interventional Radiology in Heidelberg. 'TB is the most common infectious disease in the migrant population. There's a difference between TB in the migrant population, which affects mainly young people, and TB in the host population, where it's typically a disease of the elderly.'

The main challenge for radiologists in pulmonary TB is to differentiate between active and inactive TB.

Active TB typically presents as consolidations with cavitations and formation of centrilobular nodules due to bronchiolitis after bronchogenic spread of microbacteria. Necrotising adenopathy and pleural effusion are further signs that should alert the radiologist. Inactive TB is characterised by fibronodular scarring, volume loss and calcifications. An important feature in ambiguous cases is stability of imaging findings over time, so follow-up is recommended.

Pulmonary TB is atypical in HIV+ patients; especially in patients with CD4 lympho count <20/nm typical features of TB. 'Typical features of TB like cavitation or adenopathy are lacking, and other unspecific consolidations are primary imaging findings,' Weber said.

Rapid diagnosis in this fragile population is important. also of note: TB risk is 20 times higher in HIV+ patients.

Most radiologists know that extrapulmonary TB can affect any organ, because haematogenous spread of microbacteria is almost always present during primary TB. Extrapulmonary TB can be abscess forming, but can also present with soft tissue infiltration.

'This is also a reason why extrapulmonary TB is known as the great imitator, mimicking a variety of infections and neoplastic diseases,' Weber explained.

Sometimes no imaging findings can help distinguish between intestinal TB – TB ileum – and Crohn's disease. One can detect fistula and chronic inflammation, e.g. proliferation of mesentery fat, possibly present in both diseases. In pulmonary TB, the main task is to differentiate

between active vs. inactive TB, and consider TB in any pulmonary infiltrate. 'Extrapulmonary tuberculosis should be considered in any suggested inflammatory or neoplastic disorder,' he advised.

Worm-caused diseases

Cystic echinococcosis (CE) and schistosomiasis are two other common conditions that mainly affect migrants.

CE is caused by dog tapeworm and has a global distribution. Almost eradicated in most western industrial



Tim Weber MD is a senior physician at the Institute of Diagnostic and Interventional Radiology, in Heidelberg University Hospital, Germany.

countries, there is only scarce data on prevalence in migrants – however, CE will be diagnosed in a large number of refugees or migrants.

CE causes cystic expansive mass, which can grow in any part of the body, mostly the liver or the lung. Serology test can be negative in a number of patients and imaging is essential for diagnosis.

CE shows with specific pathognomonic signs on imaging, such as the water-lily sign (CE 1), the rosette sign (CE 2), the Swiss cheese sign (CE 3b) and the ball of wood (CE 4).

'The major CE feature is that there is complete absence of vascularity, thus contrast imaging studies should be performed to exclude neoplasm,' Weber said.

Schistosomiasis, a set of diseases caused by trematode worms, or blood flukes, is very common in tropical and subtropical regions; more than 150 million people are affected in sub-Saharan Africa alone.

The worms produce eggs that are embolised via the portal vein to the liver, inducing chronic liver inflammation, which can lead to periportal hepatic fibrosis or Symmer's pipe stem fibrosis.

Here also, imaging can help, notably to differentiate between liver cirrhosis and schistosomiasis.

(MR) ■



Low-Cost Point-of-Care MRI System

Hyperfine Research Inc. is introducing the world's first low-cost, point-of-care (POC) magnetic resonance imaging (MRI) system at the American College of Emergency Physicians (ACEP) Scientific Assembly 2019. In inventing POC MRI, Hyperfine aims to make MRI available anytime, anywhere, to any patient who needs it.

Hyperfine makes MRI inexpensive, accessible, and easy to use by lever-

aging the ten million-fold improvement in computing power since the first MRI systems were designed, the revolution in green electronics, and advances in large-scale integration. Hyperfine's portable MRI is 20 times less costly, 35 times lower power, and 10 times lighter than the most popular current MRI machines.

The compact, open-design scanner wheels directly to the bedside,

plugs into a wall outlet, and allows for direct contact with the patient. It operates via a simple user interface on a tablet and does not require trained technicians, shielded electronics, or separate hospital facilities. Hyperfine potentially makes MRI available to patients who cannot safely be transported through a hospital, as well as the 4.7 billion people in rural and low-resource communi-

Hyperfine aims to make magnetic resonance imaging accessible and available anywhere, anytime, to any patient who needs it through the world's first low-cost, point-of-care MRI system. Hyperfine POC MRI device is currently 510(k) pending and is not available for sale in the U.S.

ties who have limited or no access to medical imaging.

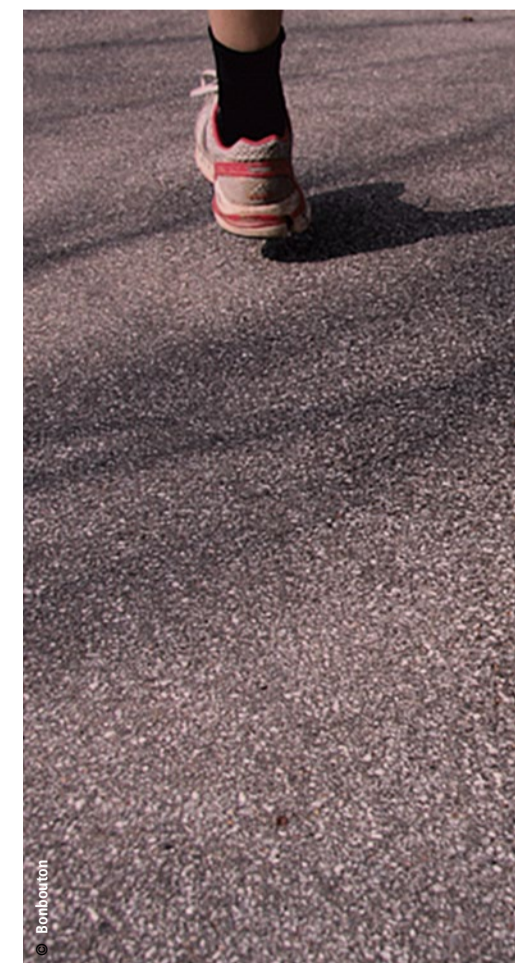
'We completely reexamined MRI from the ground up,' said John Martin, MD, Hyperfine's Chief Medical Officer. 'Our system will open avenues to reach patients in clinical settings never before imagined for MRI.'

Hyperfine's POC MRI creates standard clinical contrast images as well as informative 3D renders. Hyperfine is developing software that improves with each use via deep learning algorithms to reconstruct images and aid in the diagnosis of pathologies.

'Hyperfine is changing how medicine is practiced with point-of-care MRI,' said Jonathan M. Rothberg, PhD, Founder and Chairman of Hyperfine Research. 'More than just a revolutionary imaging system, it is a platform for new applications. Our cloud-based software development kit will enable third parties to create AI applications for our device. Ultimately, Hyperfine aims to facilitate stroke triage, continuous monitoring of unstable patients, and MRI guidance of surgical interventions.'

Smart i

Stevens Institute of Technology has signed an sensing system that detects early signs of foot



Surgery to reduce obesity-related mortality

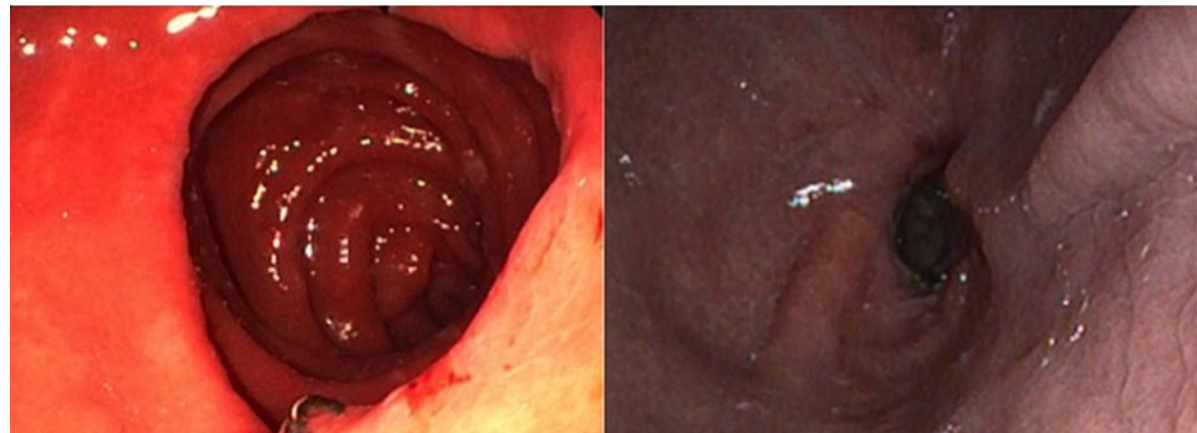
When diet / exercise do not work

Report: Anja Behringer

Obesity not only means someone is overweight but, over time, they will probably suffer sequelae that increasingly impair quality of life and are potentially fatal – these include hypertension, coronary heart disease, type two diabetes, pulmonary function disorders, tumours, plus an increased risk during surgery and anaesthesia.

In patients with morbid obesity, class three obesity, according to the WHO classification, conservative therapies such as change of diet and physical exercise rarely lead to the desired weight loss and, even more importantly, weight loss is rarely permanent. 'While bariatric surgery has been considered the last resort for patients with a BMI above 40, it can be first choice, particularly in the presence of severe co-morbidities, since it achieves significant – and permanent – weight loss and can improve or even cure co-morbidities such as type two diabetes,' says Professor Dr Thomas Rösch, Director of the Clinic and Polyclinic for Interdisciplinary Endoscopy at University Hospital Hamburg-Eppendorf.

The appropriate surgical procedure depends on the overall status of the individual patient, co-morbidities and dietary behaviour – there is no single gold standard. At Viszeralmedizin 2018, the congress of the German Society of Gastroenterology, held in September, Professor Rösch presented some new endoscopy methods for patients with



a BMI of 35 to 45.

The objectives of surgical obesity treatment have changed significantly. When bariatric surgeries were first performed in the 1950s weight loss was the one and only goal. A decade later, gastric bypass surgery was developed, which, since 1994 can be done laparoscopically. Today, the aim is a sustained 50 percent reduction of overweight. In addition, improvement or remission of obesity-related diseases, improved quality of life, prevention of sequelae and reduction of obesity-related mortality are major objectives – not to mention cost savings due to improved health status.

Prior to surgery, every single patient is recommended to undergo indication assessment conducted by an interdisciplinary team in an obesity centre, including patient information on the suitable surgery options.

The German Society for General and Visceral Surgery (Deutsche Gesellschaft für Allgemein- und

Endoscopic gastric sleeve surgery

Viszeralchirurgie - DGAV) has so far certified four excellence centres in Germany. The only university-based obesity centre is located at University Hospital Hamburg-Eppendorf and received the highest of three certification levels.

The DGAV and the International Federation of Surgery of Obesity (I.F.S.O.) demand the following criteria for surgical obesity intervention to be met:

- BMI >40 kg/m²
- BMI >35 kg/m² with severe co-morbidities
- obesity has been present for more than five years
- no metabolic diseases
- no unstable mental disease
- no alcohol and/or drug abuse

In addition, the patient must be able to cooperate and the surgical risk has to be acceptable.

The higher the complexity of the intervention – gastric band, sleeve gastrectomy, gastric bypass – the better the outcomes in terms of blood glucose management and remission rate.

Research has shown that reversible interventions such as a gastric balloon, or gastric pacing, have no long-term benefit. 'Removal often leads to relapse, that is weight gain,' says Professor Rösch. 'Nevertheless, these surgeries are frequently offered on the "grey market".'

Whilst in the past morbid obesity surgery was performed conventionally, today it is done minimally invasively (i.e. keyhole surgery). Endoscopy, a method without external access, is even less invasive. 'This less invasive access also means a reduced risk for the patient, and it is less intricate, which translates into cost savings,' says Professor Rösch.

The latter issue is important because statutory health insurers



Professor Thomas Rösch has directed the Department of Interdisciplinary Endoscopy at University Hospital Hamburg-Eppendorf (UKE) since late 2008. After medical studies at Munich's Technical University he joined its clinical team. In 2004, now senior physician and Head of Endoscopy at TU's Medical Clinic II, he was appointed Professor at Charité Berlin's Gastroenterology Clinic. Up to 2008, he headed the department of interdisciplinary endoscopy department. His clinical focus lies on diagnostics and therapy of Barrett's oesophagus and early gastrointestinal carcinoma, diagnostic endo-ultrasound and pancreatobiliary interventions using ERCP and endo-ultrasound; he also researches preventive colonoscopy care, along with gastroenterologists in Hamburg and Berlin. Since 2015 his research has increasingly taken place at the new Oesophagus Centre at UKE.

often refuse to pay for bariatric surgery. Very often, patients are not recognised as multi-morbid and surgery is not considered to have a long-term and life-saving effect. In Germany, surgeries, if performed at all, are often performed too late.

However, positive outcomes also depend to a large extent on improved infrastructure: out-patient follow-up plans for obese patients in specialised health centres offering an interdisciplinary and multimodal level scheme. The new endoscopic methods, moreover, still need to prove their long-term efficacy. Nevertheless, it might be useful to integrate them into the treatment portfolio of an obesity centre.

Insole detects signs of foot ulcer

exclusive licensing agreement with Bonbouton, giving the company the right to use and further develop a graphene insole technology that can detect early signs of foot ulcers before they form, so diabetic patients can access preventative healthcare and manage their health.



Complications from diabetes can make it difficult for patients to monitor their foot health. Chronically high levels of blood glucose can impair blood vessels and cause nerve damage. Patients can experience a lot of pain, or worse, can lose the feeling in their feet. Diabetes-related damage to blood vessels and nerves can lead to hard-to-treat infections such as ulcers. Ulcers that don't heal can cause severe damage to tissues and bone and may require amputation of a toe, foot or part of a leg. advised.

Insole fits with Sneaker or dress shoes

Bonbouton's smart insoles can be inserted into a sneaker or dress shoe to passively monitor the foot health of a person living with diabetes. The insoles sense the skin's temperature, pressure and other foot health-related data, which can alert a patient and his or her healthcare provider healthcare provider, who can determine whether a treatment is needed. This simplifies patient self-monitoring and reduces the frequency of doc-

A product image of a smart insole developed with a graphene sensing system that can help detect early signs of foot ulcers before they form.

tor visits. "I was inspired by two things: a desire to help those with diabetes and a desire to commercialize the technology," said Bonbouton Founder and CEO Linh Le, who developed and patented the core graphene technology while pursuing a doctorate in chemical engineering at Stevens.

Billions of dollars can be saved in healthcare costs

Le started to create an insole that could help prevent diabetic ulcers after several personal incidents lead him to pursue preventative healthcare. "I am excited to realize the full potential the technology that will bring seamless preventative care to patients and save billions of dollars in healthcare costs."

Stevens is a shareholder of Bonbouton (legally known as FlexTraPower) and co-owns two of the seven patents filed by the company.

EVENT NOTICES

MEDICA CONNECTED HEALTHCARE FORUM

- Wednesday, Nov 20 15:30-15:45 h

Smart Insole for diabetic foot amputation prevention

Session: Digital Prevention – From chronic disease management to wellness solutions
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UK tests high-speed remote medical diagnosis

Ultrasound scanning via a 5G network

Report: Mark Nicholls

To demonstrate advances in 5G connectivity for healthcare, a UK team has linked a paramedic in a simulated ambulance to a hospital-based clinician.

The paramedic wore a robotic or 'haptic' glove, which received signals over the live 5G network. Using a joystick, the clinician remotely directed the paramedic to move the ultrasound sensor to where on the patient the clinician wanted to scan.

Really high quality and in real-time

From this examination, high-quality ultrasound images were transmitted to the clinician in real-time, over the high-bandwidth 5G connection. In



From left: Gerry McQuade, CEO of BT Enterprise, with Fotis Karonis, BT 5G Executive Advisor, and Cameron McVittie, Operations Manager at West Midlands Ambulance Service, with the haptic glove and ultrasound used in the ambulance simulation



Andy Street, Mayor of the West Midlands, tries out the haptic glove alongside Omkar Chana, from WM5G, and Fotis Karonis and Jeremy Spencer from BT, watched by Paramedic Cameron McVittie, Operations Manager at West Midlands Ambulance Service

addition, a camera in the ambulance transmitted images of the paramedic and the patient to a second screen at the clinician's workstation to offer an overall view.

WM5G – which aims to accelerate deployment of the infrastructure needed for 5G, and is building health, industry and mobility testbeds in the West Midlands region – pointed out the benefit of enabling ultrasound scans to be performed in the field, and reviewed remotely, facilitates quicker diagnosis and onward treatment.

The demonstration was hosted by the Medical Devices Testing and the Evaluation Centre (MD-TEC), in the University Hospital Birmingham (UHB) simulation lab, at the Institute of Translational Medicine, along

with British Telecom (BT), the West Midlands Ambulance Service, and WM5G. '5G will help us to roll out this next generation of healthcare technologies,' said Tim Jones, UHB Chief Innovation Officer. 'In the future, our clinicians will be able to deliver holistic specialist advice in real time, potentially forming virtual multi-disciplinary teams to provide the best patient care using intelligent IT links.'

Doing what you cannot do with 3G or 4G

Dr Omkar Chana, WM5G programme director, added: 'The ultrasound demonstration was a flavour of what we can really do with 5G. You cannot do that with 3G or 4G. And, although it was 5G ultrasound,



Tim Jones is Executive Chief Innovation Officer at University Hospital Birmingham. He joined UHB in 1995, became Head of Service Improvement in 2002 and led the New Hospital Clinical Redesign Programme, before being appointed to the role of Chief Operating Officer in June 2006. In September 2008, he was appointed Executive Director of Delivery, which incorporates board level responsibility for Research & Innovation, Education and Workforce.



Dr Omkar Chana is programme director for citizen wellbeing at WM5G, covering health and social care and the emergency services. With a PhD in physics, his career has covered hi-tech data and analytics and business strategy specific to the NHS and healthcare, as well as mergers and acquisition.

what we are demonstrating can lend itself to any aspect of clinical imaging and real time communication. Also, it does not have to be in an ambulance, it can be in a care home, or GP surgery, and the image quality is just as good as it would be in a hospital.'

The NHS long-term plan

Technological solutions – driven by 5G – are at the forefront of the latest NHS Long Term Plan as the NHS endeavours to meet the challenges of increased demand and an ageing population. 'With low latency and the ability to communicate in real time, coupled with faster speed, massive amounts of data can be put through. With ultrasound, the clinician can see everything in real time. If he says "move left", the paramedic in the ambulance moves the probe left – immediately,' Chana observed. 'It means the clinician can decide that the patient may not actually need to go to hospital, or may need to be taken to hospital quickly and go straight into surgery because of what they see on scan.'

Smart, Portable Carbohydrate Monitoring System

A future

Innovative device to estimate carbohydrate metabolism

Kyocera Corporation (President: Hideo Tanimoto) announced that its smart, portable carbohydrate monitoring system was named the Grand Prix Runner-Up in the Smart X category at the 2019 CEATEC Awards. The first of its kind, Kyocera's carbohydrate monitoring system is designed to enhance wellness by estimating carbohydrate metabolism based on measurements of pulse-wave patterns from the user's heartbeat. It was unveiled for the first time at CEATEC 2019 in Japan, one of Asia's largest tradeshows for IT and electronics, with commercial availability planned for 2020 and applications including dietary support and managing pre-diabetic conditions.

Development Background

Kyocera developed the world's first portable wellness device for estimating carbohydrate metabolism by analyzing pulse-wave patterns with a gyro sensor. Once the user touches the device to their wrist, the monitor measures pulse waves to estimate carbohydrate metabolism in

the blood in around 8 seconds, and the result is then visualized via a smartphone. Since it uses a gyro sensor which is commonly used in everyday electronic devices such as smartphones, the company believes it will be able to offer the product at an affordable price once commercialized.

"We are honored to be recognized with such a prestigious award at CEATEC 2019," said Hiromi Ajima, an engineer at Kyocera's Medical R&D Center, who developed the device. "Using just this simple device with

Kyocera's carbohydrate monitoring system connects with a smartphone app



Photo: Business Wire

your smartphone can provide you with better information about your health and help you achieve a higher level of wellness," he explained.

About the 2019 CEATEC Awards

Selected from applications submitted before the CEATEC 2019 tradeshow, CEATEC Award candidates were judged not only from the perspective of academic, technological, marketing, and future potential, but also on the basis of pure innovation.

The Smart X category in which Kyocera was named Grand Prix Runner-Up this year includes solutions, business models, technologies, products, services, software, and applications that are judged to contribute to ground-breaking innovation in specific industries and markets – such as mobility, logistics, smart factories, smart energy, smart lifestyles, healthcare, and entertainment – contributing to the advancement of CPS/IoT and the realization of Society 5.0 (Ultra-Smart Society).

Report: Mark Nicholls

Whilst researchers acknowledge ultrasound, when used as a tool to assess intracranial pressure in an emergency, is not a replacement for current gold standard invasive approaches, they believe it has enormous potential as a non-invasive and fast, cost-effective, and patient-friendly way to assess possible brain injury at a patient's bedside.

Consultant anaesthetist Dr Chiara Robba, a specialist in the field, suggests the use of ultrasound for intracranial pressure (ICP) assessment can become standard practice in the not too distant future.

In recent years, Robba, from the San Martino Hospital in Genoa, has worked with colleagues at the University of Cambridge, United Kingdom, to explore the suitability of ultrasound to conduct brain scans in an emergency setting.

One recent study compared the relationship between ultrasound-based non-invasive ICP (nICP) and invasive ICP measurement in neurocritical care patients and found that it was a 'promising and easily available technique for identifying critically ill patients with intracranial hypertension'.

She outlined latest developments

Injured mountaineers gain in-depth exams

Ultrasound climbs the heights

Dr Philippe Mahiou practices anaesthesia in the Grenoble area, splitting his time between a private clinic and working as a helicopter doctor to attend mountaineering accidents. As part of his work, Mahiou routinely uses ultrasound, and understands the importance of the technology to guide anaesthesia in the operating room and assess patients in the field.



When anaesthetist Dr Philippe Mahiou described his use of ultrasound, he explained: 'Around 80 per cent of my work is at the Clinic des Cèdres, a private clinic near Grenoble, where approximately 7,000 to 8,000 trauma and orthopaedic procedures are performed every year. I frequently use ultrasound to guide injections for locoregional anaesthesia, after first discovering the benefits of this technique in 2007. The main advantage is that you can visualise the nerve very precisely; it's not necessary to use neurostimulation to look for the nerves instead.'

'Our Fujifilm SonoSite systems offer excellent image quality; you can even visualise nerves in the feet, which are very small and often hard to see. It is also easy to move the systems around and adjust their height, which is perfect for point-

of-care applications. Additionally, we can save images and export them, which is great for teaching, as are the locoregional anaesthesia educational training videos on our X-Porte systems.'

Alpine ultrasound exams

'The remaining 20 per cent of my work is as a mountain rescue doctor for the Grenoble University Hospital. I've been in this role for 18 years or so. After using ultrasound for anaesthesia in the operating theatre, I began using it on mountain rescues over 10 years ago. People who have mountaineering accidents often suffer from all kinds of thoracic, cerebral, abdominal, spinal and pelvic injuries, and so it's vital for us to reach and treat the patient as quickly as possible. For this reason, the mountain rescue heliport is based

in Alpes d'Huez, which reduces the average intervention time.

'We're the second largest mountain rescue base in France after Chamonix, and receive about 1,000 calls per year from the Grenoble Operations Centre, which gives us the coordinates we need to reach each patient.

'The team is made up of five individuals; a pilot, mechanic, two rescuers, a doctor, such as myself, and in avalanche cases we often also use rescue dogs. We carry the same kit as an emergency department – all the equipment necessary to resuscitate in the field – packed into two bags. The first bag weighs about 25 kg, and carries all of the equipment to reduce and try to stop heavy bleeding, or treat patients suffering cardiac arrest, as well as our portable ultrasound system, while the second bag contains supplementary equipment for resuscitation.'

Triage and monitoring

'We use ultrasound as part of the clinical examination of each patient to diagnose any problems, assist with pain management and monitor them on route to hospital. We therefore need a compact and robust device that can start quickly and be used in extreme conditions. When we arrive at a patient, we start by checking the pulse, blood pressure and respiratory rate, before performing an ultrasound scan. We begin with a FAST examination – to check whether there are any transabdominal effu-

Dr Philippe Mahiou uses ultrasound to visualise very small nerves in the feet.

sions – then we use ultrasound to guide regional anaesthesia for pain management, including femoral, interscalene, infraclavicular, medial, radial and ulnar blocks as required.

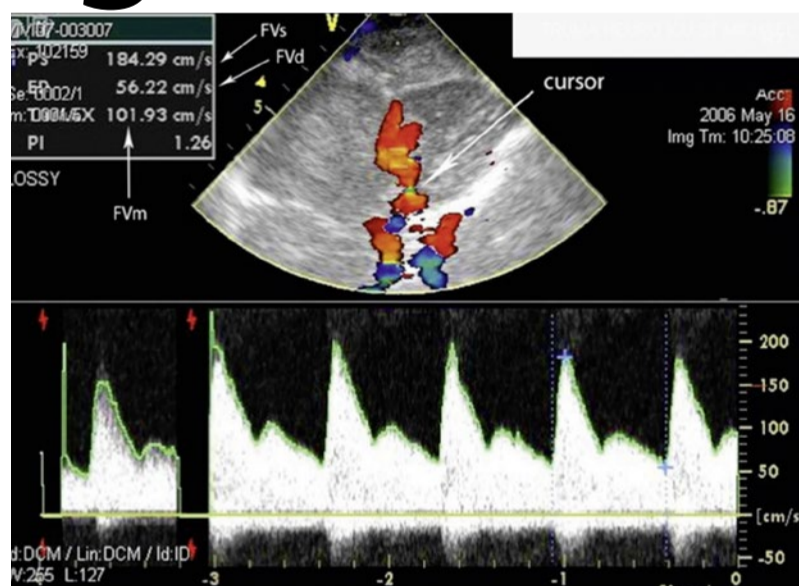
'We often also conduct pulmonary, cardiac and transcranial Doppler ultrasounds to help us decide which hospital is best to send the patient to, depending on the severity of the trauma. A lot of our patients suffer cranial injuries, and identifying these means we can send patients straight to the neurosurgery department on arrival at the hospital, for more immediate emergency treatment.

Another benefit of ultrasound is that you can use it to monitor a patient if their health is deteriorating. For instance, we regularly repeat FAST examinations and discover transabdominal effusions that hadn't had time to form before we conducted the initial scan.

'Overall, ultrasound is a really valuable and versatile tool both in the clinic and out in the field. It has improved the quality of patient care immensely. I don't know what I'd do without it.'



re gold standard tool



Non-invasive ICP can be estimated through waveform analysis of the main cerebral arteries. This is an example of transcranial colour duplex sonography with the insinuation of the middle cerebral artery.

in the field during her presentation 'An update on the use of US for the estimation of intracranial pressure in emergency' at the 21-24 February annual congress of WINFOCUS (World Interactive Network Focused on Critical Ultrasound), held in Dubai.

'Over the last few years, we've realised that the use of ultrasound for the brain is suitable in an emergency

setting,' Robba explained. 'When a patient arrives in the emergency department, a doctor performs an assessment of the body using ultrasound and that generally includes assessment of the heart, lungs and abdomen, but not the brain.'

A wide range of pathology

'But you can use ultrasound to provide a lot of information, even when the patient has just arrived in the emergency department. That includes a wide range of pathology like increases of intracranial pressure or reduction of cerebral perfusion pressure or you can also have a direct assessment and visualisation of intracranial haematoma or haemorrhage.'

A key reason why ultrasound has not been used previously in this context is due to difficulties of accessing the brain encased in the skull. 'Ultrasound waves cannot pass through the bone so sometimes it's difficult to visualise the brain,' Robba pointed out. 'But if you use the "windows" – temporal, transorbital, submandibular and suboccipital windows – you can have a proper look at the brain.' This is also a valid care standard for patients who undergo decompressive craniectomy, she added.

Use of ultrasound for ICP assessment requires training, commitment and study, but Robba believes this should be encouraged because of the benefits. 'You can visualise cerebral pathology; get early identification of intracerebral haemorrhage or intracranial cerebral complications without having to transfer the patient for a

CT scan, which can be painful for a patient who is haemodynamically unstable. Also, CT requires the use of radiation and cannot be performed

at a patient's bedside, so the advantages are many.'

Her study team in Genoa and Cambridge is setting up training programmes and writing a book to complement courses already available at

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Biopsies with MRI-compatible ultrasound system

Biopsies are standard procedures in interventional radiology, not least for patients with a suspected tumor. In this instance, MRI is increasingly the method of choice for guiding minimally invasive tissue sampling. In an ongoing R&D project, Fraunhofer researchers have now developed a system that allows acquisition of ultrasound images simultaneously to an MRI scan.

These multimodal data are then combined and mapped onto one another, meaning that the high-contrast MRI images can still be utilized, in combination with the live ultrasound images, once the patient is no longer inside the MRI scanner. In other words, only one MRI scan is required at the beginning of the biopsy procedure. Afterwards, the biopsy can be safely performed under the guidance of a combination of real-time ultrasound images improved with MRI contrast.

Scientists from the Fraunhofer Institute for Biomedical Engineering IBMT have teamed up with fellow scientists from the Fraunhofer Institute for Digital Medicine Mevis and from Saarland University Medical Center to create the system, named Kombus.

This combination of high-contrast MRI images and live ultrasound images enables to plan the needle path without the need for repeated MRI scans. "Each time the patient breathes in or out, the positions of the internal organs shift," explains Dr. Marc Fournelle, scientist at Fraunhofer IBMT. "The physician must therefore plan and perform the biopsy in one and the same breathing phase."

Tests on a phantom model have demonstrated the proper functioning of the hardware-software combination. Clinical studies are expected to get under way over the coming months. In addition, the research team will be presenting their system at the joint Fraunhofer booth (Hall 10, Stand G05) at Medica.



Source: Fraunhofer IBMT

DiPhAS KOMBUS: an MRI-compatible, 256-channel ultrasound system.

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Cambridge University.

While there remains a lack of awareness of the potential of this relatively new technique, she believes it can become a care standard for patients in emergency units, intensive care or the operating theatre where patients are at risk of neurological complication, as well as at the bedside and to be used in the same way ultrasound is deployed to monitor the rest of the body.

For a clinician, she explained, performing a brain ultrasound at the bedside can identify issues of concern and prompt further tests – or offer reassurance that all is well. 'From a patient's perspective, it is safe monitoring, does not cause any harm but adds information. When it becomes routine clinical practice, it's going to reduce the number of CT scans, the number of radiation exposures and transfers.'

20 international experts

Over the last two years, exponents of the technique – including Robba – have been presenting US potential at conferences, and she is currently working with 20 experts from around the world on a consensus paper as well as looking at training requirements, standards and competences for practitioners to be able to use ultrasound as a technique to assess the brain, including the estimation of ICP in an emergency.

Yet, amid the enthusiasm for the new development, Robba also urges caution because the scientific evidence still



Chiara Robba is a consultant in anaesthesia and intensive care at the San Martino Hospital in Genoa and an honorary consultant at Cambridge University Hospital in the UK. Her research interests cover ultrasound for intracranial pressure, traumatic brain injury, intracranial haemorrhage, and areas of general intensive care, including mechanical ventilation and sepsis.

needs to be assembled and she stressed the technique should not replace the gold standard invasive methods to measure brain trauma pressure because there are limitations to the ultrasound approach with just the four "windows" for assessment.

However, Chiara Robba concluded: 'The benefits are potentially huge. In the future I think this should become a standard of care in the same way as echocardiography is for the heart.'



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