Viewpoint: Cardiac Ultrasound

Raimund Erbel, MD, who has worked in the field of cardiac ultrasound for over 30 years, discussed the role of his speciality and its future with Monika Polak, PhD.

Ultrasound is a workhorse for cardiologists, and will continue to be so despite the advent of sophisticated imaging techniques such as computed tomography (CT) and MRI, according to Raimund Erbel, MD. Dr Erbel is a professor of medicine/cardiology and has been director of the Department of Cardiology at the University Clinic, Essen, in Germany since 1993. He has worked in the field of ultrasound for more than 30 years.

Dr Erbel studied medicine at the Medical University of Cologne and the University of Düsseldorf before specialising in cardiology at Düsseldorf. He continued his training in Koblenz, Aachen, before qualifying as a consultant at the university Aachen in 1982.

Throughout his career, he has seen ultrasound develop in technological terms and in the way it has been applied across the field of cardiology. Ultrasound has driven cardiology forward, and Dr Erbel says echocardiography, at least in part, has forced medical textbooks to be rewritten, in that diagnoses that were new to clinicians such as inter-atrial septum aneurysms, vegetations, and patent foramen ovale, became well-known terms. More importantly, he says ultrasound is a developing science, especially in the areas of diastolic heart failure and resynchronisation therapy.

Dr Erbel’s first contact with ultrasound was during the 1970s, whilst still a student, although he was denied the opportunity to explore the potential temporal resolution achievable with the technique at this time. It was not until he arrived at Aachen in 1977 that Dr Erbel could transfer his knowledge of analysing angiograms to echocardiograms.

The main drawback of cardiovascular ultrasound, he says, is the limited spatial orientation. However, he cites many advantages. Ultrasound enables patient examination without risk and virtually no discomfort. Subjects do not have to experience the claustrophobic environment of a scanner, which is an important issue for the 5% to 10% of patients who are afraid of entering one.

Ultrasound is also convenient for the clinician. Dr Erbel says that miniaturisation of the technology has dramatically altered the use of echocardiography. Because the consultant can come to the patients, they no longer need to be transferred to another area of the hospital for scanning. These days, only if there are difficult diagnostic questions to answer does a patient need to head to the echocardiography room. Furthermore, image resolution is now extremely good.

These developments have enhanced echocardiography in the field, and in Dr Erbel’s experience, clinicians using laptop echocardiography scanners are reluctant to use any other technique. No cardiac surgeon could imagine working without this tool, he adds. Dr Erbel also says there is good agreement across Europe regarding the use of echocardiography. The Working Group on Echocardiography of the European Society of Cardiology has helped build this consensus and has initiated several European multicentre trials investigating the technique.

Tissue Doppler echocardiography improves structure identification, such as vegetations of infective endocarditis (arrowed, left), and a left ventricular thrombus separating from the myocardium (arrowed, right).

But with newer and increasingly sophisticated imaging techniques such as MRI, is there a danger that ultrasound will be left behind? Dr Erbel thinks not. He believes that these new techniques will be introduced in the field when they begin providing answers that cannot be obtained through the use of existing methods such as echocardiography. For example, CT scanning is ideal for assessing the extent of coronary artery...
calcification and atherosclerotic plaque formation, and is a unique tool for the cardiologist, says Dr Erbel.

MRI, while time consuming, has the benefit of wonderful spatial orientation, he explains. In addition, the general physician might find it easier to understand an MRI scan, as it is easier to discern distinct anatomical features. MRI has developed areas of investigation that cannot be seen using ultrasound, Dr Erbel says. For example, clinicians now look to MRI when seeking signs of myocarditis, and when attempting to describe the thickening of the pericardium in pericardial disease.

Dr Erbel thinks it likely that MRI will overtake nuclear techniques and ultrasound in the area of myocardial perfusion. But these are specific niche areas in cardiology, and Dr Erbel believes ultrasound will maintain its central position in cardiac imaging. He explains that the technique has become established as an effective diagnostic tool for aortic dissection, endocarditis, and embolic disease. He adds that the advent of transoesophageal ultrasound in the 1980s brought enhanced image quality, improving surgical decision-making.

The haemodynamics of the left ventricle can be described better with ultrasound than with other imaging techniques because the details are so large and clear, and clinicians and researchers can obtain more information this way. Furthermore, clinicians are now working with a temporal resolution of 1000 frames per second in ultrasound, far beyond the capabilities of MRI and CT. In myocarditis and acute MI, ultrasound can very quickly show restoration of function or development of complications, although more training and guidance are required for these more sophisticated undertakings.

Ultrasound is operator-dependent, and the performance of echocardiographic examination is related to the training and skills of the examiner. But, Dr Erbel says, this is not unique to ultrasound, and holds true for any imaging method. He says that the accurate interpretation of echocardiograms, as well as MRI and CT, requires a thorough knowledge of cardiovascular diseases. In all cases, a cardiologist, not just a radiologist, should interpret the information, in order to put the findings into a correct cardiological context.

Dr Erbel believes training should begin in the echocardiography room and then move to the catheter laboratory rather than the reverse, as has always been the case, because echocardiography now provides such detailed information. He feels there is not much difference between Europe and the United States in terms of ultrasound use and practice, but there certainly seems to be a difference in terms of education, with the United States currently leading on this front, and also in its use of sonographers for constant, standardised high-quality echocardiographic recordings.

Apart from the training issue, although many European institutions are now making more use of their data, Dr Erbel believes Europe as a whole needs to do more in terms of data analysis. A wealth of data is generated during an echocardiographic examination, and Dr Erbel’s department routinely performs detailed analysis. A period of collaborative work he undertook in 1987 with the Mayo Clinic, Rochester, Minn, revealed that this is also standard practice on the other side of the Atlantic.

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Three-dimensional echocardiography holds great promise. It uses two longitudinal planes (A and B) and a cross-sectional plane (C).

So what of the future? Besides remaining the primary diagnostic choice for clinicians in the field, ultrasound will increasingly be used to follow the effects of therapy, Dr Erbel predicts. In addition, 3D echocardiography holds great promise.

Currently, the resolution for 3D echocardiography is not optimal, but no other imaging technique can provide real-time 3D images that can demonstrate cardiac pathology and detect abnormalities. Dr Erbel predicts this will become a fantastic preoperative tool for surgeons. It seems that the future is certainly bright for ultrasound, and that it will remain the workhorse of modern cardiology.

Monika Polak is a freelance medical writer.

The opinions expressed in *Circulation: European Perspectives in Cardiology* are not necessarily those of the editors or of the American Heart Association.

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**Spotlight on a Young Cardiologist**

**Maurizio Pieroni, MD, PhD,**
who won a Young Cardiologist award in 2005, talked to
Monika Polak, PhD, about his experiences and ambitions.

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Dr Maurizio Pieroni is a research fellow at La Sapienza University in Rome. He considers cardiac pathologies central in medicine and is fascinated by how the outcome of cardiac disorders can be altered with drugs and interventional procedures that directly manipulate cardiac function.

Dr Pieroni’s interest in cardiology began when he decided to be a doctor, and this was heightened by the opportunity to train with Attilio Maseri, MD, FACC, whom Dr Pieroni labels “one of the world’s greatest cardiologists.” Dr Maseri was professor and head of cardiology at the Catholic University School of Medicine in Rome when Dr Pieroni began his studies there in the early 1990s. Dr Maseri instilled in the
fledgling cardiologist the notion that research is a relevant part of medical activity and that it must always start from clinical problems and observations.

Dr Pieroni graduated from the Catholic University cum laude in 1997, obtaining his specialisation in cardiology in 2001 at the same institution. He spent 2 years working in the intensive care unit at San Raffaele Hospital, Milan, before moving to La Sapienza University in 2004. Last year he obtained his PhD in human pathology. Whilst at the Catholic University, Dr Pieroni worked with Andrea Frustaci MD, who introduced him to the study of cardiac pathology, trained him in endomyocardial biopsy and taught him most of what he now knows about cardiomyopathies, myocarditis and cardiac pathology in general.

He still works with Dr Frustaci in the endomyocardial biopsy and myocardial diseases laboratory at La Sapienza University, a unit dedicated to studying myocardial disorders, including cardiomyopathies, myocarditis and heart failure (HF). Endomyocardial biopsies are taken to provide a definite diagnosis, and also to understand the mechanisms of disease. Dr Pieroni says the experience continually reinforces his conviction that good research improves clinical skills. Although his time is equally divided between patients and research, all his clinical activities focus on disorders of interest to the research team.

He says the most exciting part of his work is the ability to relate the clinical problems he sees to the pathology by directly observing myocardial tissue with the aid of microscopy — a “face-to-face” meeting with the disease responsible for cardiac symptoms. He cites an example — identification of inflammation in myocardial biopsies from patients with HF, followed by complete recovery of cardiac dimensions and function in many patients who respond to immuno-suppressive treatment. This is an impressive clinical event, he says, giving him the impression of having provided a complete service, from diagnosis to treatment, which marries clinical practice and research.

His enthusiasm and dedication have reaped their own rewards. In September 2005 Dr Pieroni received a Young Investigator’s Award at the European Society for Cardiology’s annual congress in Stockholm. The award was for his paper on the role of the neuroendocrine hormone chromogranin A (CgA) in myocardial tissue. The 33-year-old cardiologist says the award recognised the value of his research and provided him with the impetus to continue.

The study, in collaboration with San Raffaele Hospital in Milan, demonstrated that CgA, which is elevated in HF and has been regarded as a marker of disease severity, is synthesised by myocardial tissue and is co-stored and co-released with brain natriuretic peptide.

Moreover, administering CgA to the isolated perfused rat heart significantly reduced left ventricular contraction and relaxation. What Dr Pieroni finds remarkable is that CgA plasma levels are elevated in patients with systolic as well as diastolic HF. He therefore suspects CgA not only reflects disease severity, but also contributes to cardiac dysfunction, possibly by affecting calcium ion handling in myocytes. The next step is to try to block CgA with specific antibodies and drugs.

Dr Pieroni was drawn into this research after noting that in myocardial biopsies, cardiac dysfunction is not sustained by loss of myocytes but rather by severe dysfunction and damage of myocardial cells that are still alive. In addition, while some patients with severe cardiac dysfunction have only mild symptoms, others with mild dysfunction have severe symptoms.

Thanks to new technologies and drugs, HF patients live longer and have a better quality of life. But much work is needed to change outcomes and the natural history of the disease, Dr Pieroni says, and focusing on molecules such as CgA may provide novel therapeutic targets.

Longer-term patient follow-up, with regular investigations including ECG and echocardiography, would also help. He suggests providing a free telephone helpline that patients could call to discuss any new symptoms as they develop. This would allow a more rapid alteration of their drug regimen, Dr Pieroni says. More detailed follow-up could also provide important information on the impact of interventions, changes in hormonal profile and levels of cytokines that affect myocardial function.

Dr Pieroni expects the next breakthrough in cardiology will involve HF. He believes HF should be the cardiological challenge for the third millennium, as prevalence and mortality are increasing. Cardiologists should try to define the cause of patients’ HF, rather than simply labelling them as having HF. This could require invasive testing, he says, but if it improves interventions and outcomes, it is worth doing. His long-term aim is to create a centre dedicated to the study of cardiomyopathies, providing complete patient assessment from clinical evaluation to genetic analysis and myocardial tissue studies.

Dr Pieroni says that in Italy not all hospitals are associated with a university, so young cardiologists may choose between a university career, including research, clinical activities and teaching, or a hospital career with clinical duties, although research is not excluded. Starting a university career is quite difficult because of the limited number of positions available and the complex methods of selection. Many non-university hospitals have excellent cardiological centres, so young cardiologists in Italy who have an interest in research can work in hospitals of outstanding quality to improve their clinical skill, and still have opportunities to do good research.

Dr Pieroni is content to remain in Italy and play his part in fostering research links within the country. He says that although Italy is a good place for clinical cardiology and research to coexist, cooperation between research centres must improve to prevent talented Italian researchers heading to the US to fulfil their research aims. Other reasons to stay in Italy are the benefits of the Mediterranean diet, and traditional Tuscan cooking, which Dr Pieroni is rediscovering in his spare time. Another key aim for the art–and–cinema–loving Juventus soccer fan is to marry his girlfriend Annalisa, and then travel around Australia “as soon as possible”.

Monika Polak is a freelance medical journalist.
Training Children to Save Heart Attack Victims

A scheme to teach cardiac resuscitation in schools that began in Seattle is being introduced in English schools. Mark Nicholls looks at how schoolchildren can become the lifesavers.

Thousands of heart attack victims across the United Kingdom may have a better chance of survival thanks to a training initiative aimed at schoolchildren. The children are being taught cardiopulmonary resuscitation (CPR) after it was shown that such schemes introduced in the United States resulted in a dramatic improvement in survival rates of people suffering sudden cardiac arrest (SCA). This was attributed to an increase in public knowledge of CPR, with greater readiness to respond instantly. Enthusiastic volunteers, who are cascading their knowledge down into the community in special training sessions, are introducing the scheme in the United Kingdom.

Within the county of Norfolk, ambulance technician Jeanne Reynolds and paramedic team leader Peter Simpson, both from the East Anglia Ambulance Trust, embraced the project. With colleagues, they formed Heartstart Medics (Norwich), and initially began training people such as police officers, care workers, and volunteers in resuscitation techniques. The project is affiliated with the British Heart Foundation (BHF) through its Heartstart scheme, a programme that has so far trained 1 200 000 people in the United Kingdom to do CPR.

The project leaders are now extending the training to schoolteachers, who are then encouraged and supported to pass their knowledge on to their pupils. The training is not part of the school curriculum, but its success has led the project leaders to press UK Government ministers — including Health Secretary Patricia Hewitt and Education Secretary Ruth Kelly — to formally introduce and fund Emergency Life Support (ELS) training in schools.

Jeanne Reynolds is the Heartstart Medics (Norwich) co-ordinator, and she said, “Children are our biggest lifesaving asset for the future, and if taught these skills whilst in school they will take them through to their adult life.” She explained that what triggered their campaign was an eye-opening visit to Seattle in the United States.

They were impressed by data provided by the Seattle Emergency Medical System, which shows that as many as 45% of people with SCA survived. This is a remarkable percentage when compared to only 2.86% survival in Norfolk, according to figures from the East Anglia Ambulance Trust Cardiac Arrest Continuous Audit Report for April-October 2005.

The key factor in the low percentage was that CPR was not administered before the arrival of an ambulance, either because people were reluctant to do so, or because they were uncertain of what to do. As a result of Reynolds’ and Simpson’s concerns, they became affiliated with the BHF Heartstart initiative, which funds the equipment needed for training, and began their training programme in CPR with people from their community.

The idea to move training into schools came after Mr Simpson answered a 999 call for a man who suffered SCA outside a village school, where the children were unable to help. From there, the scheme has been implemented and there are plans to cover all of Norfolk’s 114 000 schoolchildren in 457 schools.

So far, more than 220 teachers and classroom assistants have received the necessary training to become Heartstart instructors since May 2005, and they are now passing their knowledge on to schoolchildren. The aims are to ensure that at least 10% of Norfolk schools a year have the opportunity to take part in the scheme, and in the long term, that 80% of school-leavers should have been offered ELS training. Other areas of the United Kingdom, such as Leicester and Sunderland, are now taking up the scheme, but Norfolk is leading the way.

During their training, pupils learn how to put the individual in the recovery position, how to recognise a heart attack, how to give CPR, and how to deal with choking and clearing the airway. Children are taught the skills over 10 sessions.

Ms Reynolds and Mr Simpson believe the scheme will save lives. Mr Simpson said, “The reason behind Seattle’s success is that for the last 30 years all schoolchildren have been taught simple, basic life support skills, and we want to emulate that achievement.”

A typical reaction from teachers comes from Gill Leah, who said, “We like the idea of children being able to help others. At the end of the sessions, I hope that the children will be calm in an emergency and be able to do the right thing for the patient. They will keep the knowledge over the years and it will become second nature to them.” An 11-year-old pupil, George Mardle, agreed. “These lessons will help us save lives. If someone is ill, we will be able to help them,” he said.

The project leaders have found much enthusiasm in schools. “Teachers can see the benefits, and we believe there should be a fourth ‘R’ on the curriculum, for resuscitation,” they said. “What we want is for these skills to be part of the curriculum, and we are going to keep lobbying until we get that result.”

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