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EDITOR'S COMMENT

Crown years for noninvasive cardiovascular imaging (part I): 60 years of echocardiography

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'*A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.*' Max Planck (1858–1947)

The year 2013 is a remarkable year in cardiovascular medicine from a historical point of view. It can be considered a crown year for noninvasive clinical cardiovascular imaging as we can look back on 60 years of echocardiography, 40 years of nuclear cardiology, 30 years of cardiovascular magnetic resonance imaging, and 30 years of cardiac computed tomography. Acceptance of the noninvasive imaging techniques was not always an easy-going pathway and most of them initially encountered a lot of scepticism. In this Editor's Comment, which is part 1 of a four-part series on the history of noninvasive cardiovascular imaging, we will briefly look back to the roots of echocardiography and its main achievements.

Echocardiography 60 years

The development of diagnostic ultrasound in cardiology started in Lund, Sweden in 1953, originating from the successful cooperation between the physician Inge Edler (1911–2001) and the physicist Hellmuth Hertz (1920–1990). The first echocardiographic recording in man was performed on Thursday 29 October 1953 and published in 1954 [1]. Equipped with the 'Ultraschall Impulsgerät' (the Siemens Ultrasound Reflectoscope), Inge Edler and Hellmuth Hertz recorded the first moving pictures of the heart, thereby inaugurating the field of 'ultrasound cardiography', at that time called UCG. The first echoes, recorded via M (motion) mode, were obtained from the posterior wall of the left ventricle and from another structure thought to be the anterior wall of the left atrium. The invention of ultrasound echocardiography marked the beginning of a completely new diagnostic noninvasive technique in cardiovascular medicine. Edler used this technique primarily for the preoperative study of mitral valve stenosis and diagnosis of mitral regurgitation. The Swedish efforts were further conveyed by European and American research groups. Harvey Feigenbaum (Indianapolis, USA) sought answers in ultrasound because he was '*frustrated with the tediousness and inaccuracies of using the catheterisation techniques to measure the cardiac output, volumes and pressures*'. In the late 1960s, Feigenbaum, who in fact coined the name echocardiography, showed that left ventricular wall thickness, internal dimensions, stroke volume, ejection fraction, and valvular regurgitation could all be measured by echocardiography [2]. In the Netherlands, the group headed by Professor Nicolaas Bom (Rotterdam, and ICIN, Utrecht) had already made major breakthroughs with the development of a multi-element linear array transducer making real-time imaging possible in 1971 [3]. From that moment on, the first successful two-dimensional echocardiograms were performed allowing the visualisation of wall motion abnormities in patients with coronary artery disease [4, 5]. In 1973, Johnson and Dodge [6] combined two-dimensional echocardiography with pulsed Doppler imaging to enable the detection of flow signals from specific locations within the heart or great vessels; duplex scanning was born. Simultaneously, another major breakthrough in Doppler came in 1976, when Holen [7] and later on Liv Hatle (Trondheim, Sweden) noted that a modified Bernoulli equation could be used to detect pressure gradients across stenotic valves and demonstrated that haemodynamic

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data could be accurately determined with Doppler ultrasound [8]. In an effort to attain a better visualisation 'window,' Frazin and colleagues [9], in 1976, accomplished transoesophageal echocardiography. Further pioneering research in echocardiography in the Netherlands was performed by (among others) the professors Jos Roelandt (Rotterdam), Cees Visser (Amsterdam, and ICIN, Utrecht), Ton der Steen and Nico de Jong (Rotterdam, and ICIN, Utrecht), and Jeroen Bax (Leiden) [10–14]. Important technical advancements in the ultrasonic field, such as intravascular ultrasound, three-dimensional echocardiography, contrast echocardiography, intracardiac echocardiography, dobutamine-stress echocardiography, speckle tracking and handheld echocardiography ('the virtual stethoscope') have made echocardiography the most widely used noninvasive cardiovascular imaging technique in the world [15, 16]. For a wide variety of cardiovascular diseases, echocardiography has become the noninvasive imaging technique of choice [17–20].

For his landmark discovery of cardiac ultrasound in 1953, Inge Edler is recognised as the 'Father of Echocardiography' [21]. Of note, Hellmuth Hertz (son of the Nobel Prize laureate Gustav Hertz) , who created new techniques for two-dimensional echocardiography and for measuring the rate of blood flow by the Doppler effect, had disappointedly left the field of cardiac ultrasound because he was given no support in the form of grants from the Swedish Board of Technical Development. The Board's advisors believed '*that the method lacked 'medical' and 'commercial' interest*'! Memorising the words of Max Planck at the head of this article, the new generation of cardiologists has become completely familiar with echocardiography and has fully embraced the 'new scientific truth'.

N.B. This Editor's comment does not pretend to be complete and more detailed descriptions of the history of echocardiography can be found in publications by the Rotterdam group [22–24]. An extensive review of the echocardiographic achievements in the Netherlands was published in the *Netherlands Heart Journal* in 2008 by Dr. Otto Kamp (Amsterdam) [25].

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