

Joint Event on

PEDIATRICS, NUTRITION & PRIMARY HEALTHCARE NURSING

July 16-18, 2018 Dubai, UAE

Heart sounds auscultation, past, present and future

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Heart sound auscultation has been used as a screening technique for investigating cardiac condition over thousand years. There are evidences showing that this technique was used during ancient Persian and Egyptian civilization to verify heart condition but, the biggest breakthrough came on 1816 when the French physician, René Laennec, invented the first stethoscope by curving a wooden cylinder. After the invention of stethoscope, many diagnostic features of this technique were understood by the physicians and later, the phonocardiography became an important tool for cardiac diagnosis in the 1950s. This tool provides a plot of heart sound recording on a rolling paper. However, after the creation of cardiac ultrasound imaging in Lund, Sweden, phonocardiography became less appreciated by the cardiologists due to the informative graphical representation, provided by echocardiography, which is still recommended by the pertinent associations as the tool with central role in diagnosis. In Doppler echocardiography, disease diagnosis is based on the direct and indirect measurement and calculation of the operator. This attributes a subjectivity to the approach, even though it has been objectively accepted by the cardiology community, which is considered as a drawback of the approach that limits its application to the expert clinicians, and access to such expert clinicians is not easy specially in the rural places. Heart sound auscultation is therefore, employed in all the medical settings as the first screening approach, which is by far a less expensive method. Due to progresses in signal processing and artificial intelligence, many studies aimed to associate intelligence with the heart sound auscultation technique to improve screening accuracy in cardiac auscultation specially, in children, where the accuracy is substantially impaired by innocent murmurs. A study in Johns Hopkins University, USA, showed that the screening accuracy in pediatrics cases is as low as 40% in family doctors, which can be rather improved by using computer-assisted auscultation. An automated tool for screening congenital heart disease in infants and in children is achievable by using our unique processing method, named Arash-Band, that has been internationally patented. Such a processing method was incorporated into appropriate graphical user interface and installed on a portable processing unit, to be employed by the practitioners or nurses in primary healthcare centers for an improved screening. This automated system, which we call it Pouya-Heart, has great compliance with echocardiography for detecting CHD and CCHD. Our proposed digital phonocardiograph is now available on the market. One of the interesting capability of the system is its discrimination power in separating innocent murmurs from the pathological ones. Further efforts have been made to lift applicability of the digital phonocardiograph from the screening to diagnosis by adding intelligent algorithms for the disease detection. The Arash-Band method could be implemented on smartphones and web technology, which will result in a homecare system for pediatric heart disease screening. It is implied that the digital phonocardiograph tends to provide rather diagnostic information in the future and avails echocardiography to those of need, where decision for an appropriate therapeutic is critical.

Biography

Amir A Sepehri has received his B S E E from Auburn University, USA and his PhD from Mons University, Belgium on Digital Audio Signal Processing. He has worked on a special research program on 'Computerized Screening of Congenital Heart Disease' for 16 years. He is currently the Director of CAPIS biomedical R&D department, with close R&D co-operation with scientific members of Innovation Design and Technology department of Mälardalen University in Sweden.

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