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The use of cardiac magnetic resonance imaging (CMRI) for adult congenital heart disease patients: qualitative comparative review

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Introduction

Grown-up congenital heart diseases (GUCH) are a new field in cardiology due to historically high childhood mortality rates.[1] Compared with 60 years ago, pre-adulthood mortality rates have dropped from 90% to 10%. Once they become an adult, patients with GUCH need follow-up and monitoring of their conditions.[2] Many of them need lifelong monitoring, and thus the need for a reliable imaging modality emerges.

Materials and methods

This study compares different imaging modalities based on their innate characteristics plotted against a virtual ideal test, as well as the different societies' guidelines, utilising a qualitative approach to the comparison. A systematic search for evidence was conducted looking into resources such as PUBMED, EMBASE, ScienceDirect, CINAHL, NICE, ESC, ACC/AHA using Boolean operators with phrases like: 'CMRI', 'GUCH', 'ACHD', 'diagnostic modalities', 'imaging techniques'. After primary selection of included resources, the studies were analysed for inclusion in the body of evidence.

Results and discussion

Cardiac magnetic resonance imaging (CMRI) has no radiation risk but offers lower resolution than computed tomography (CT); it is more time consuming and therefore, more demanding for clinicians and patients.[3] It is less operator dependent than echocardiography which allows for detection of minor changes in serial follow-up assessments mainly for left ventricular volume and function. CMRI is also applicable in pregnancy. On the downside, it is contraindicated in the presence of certain pacemakers, and it cannot be utilised intra-procedurally. CMRI is also prone to artefacts that can be identified through chest X-ray, such as retrocardiac surgical needle in one case.[4]

CMRI is uniquely indicated in right ventricular volume and ejection fraction assessment, as well as for abnormalities in the great vessels and for pulmonary artery conduits.[5] CMRI is rarely done as a first-line test. Usually, it is utilised to answer predetermined morphological and haemodynamic questions of already configured anatomy.[4] Furthermore, the latest developments of 4D-CMRI carry the potential of identifying risk profiles and treating patients before developing clinical manifestations by recognising areas of wall strain and flow patterns.[6]

Table 1. Point scoring of different imaging modalities in grown-up congenital heart diseases. The values are based on the research conducted in the study.

	MRI	TTE	CT
Extra-cardiac data collection	+++	+/-	+++
detection of smaller changes (i.e. LV size, ...)	+++	++	+++
no radiation exposure	+++	+++	-
non-invasive	+++	+++	+++
operator independent	+++	+	+++
special circumstances: pregnancy	+++	+++	-
Total	18/18	12.5/18	12/18

CT = computed tomography; LV = left ventricular; MRI = magnetic resonance imaging; TTE = transthoracic echocardiography.

Conclusion

No single test is perfect for all patients with GUCH all of the time, but CMRI proves to be near perfect when it comes to serial follow-up and definitive diagnosis (Tables 1 and 2). It falls short when faced with ferromagnetic foreign bodies, intraoperative imaging, emergencies, suboptimal patient

Table 2. Overall numerical qualitative value for different imaging modalities in grown-up congenital heart diseases

Imaging modality	Marcotte *et al*[7]	ACC/AHA[8]	This study	Total
MRI	33	14	18	**65**
Echocardiography	26	9	12.5	**47.5**
Cardiac CT	23	12	12	**47**

ACC = American College of Cardiology; AHA = American Heart Association; CT = computed tomography; MRI = magnetic resonance imaging.

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cooperation, or with vegetations and small thrombi where cardiac CT is superior; and it is more expensive (than echocardiography) to be used for initial patient assessment. ■

Conflicts of interest

None declared.

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