

Cardiac magnetic resonance imaging; gatekeeper in suspected CAD?

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Nowadays, the impact of cardiovascular imaging on the overall healthcare system is substantial. Every year five billion imaging tests are performed worldwide, and about half of these are cardiovascular examinations [1–3]. It is estimated that nearly 8 million SPECT studies are now performed annually in the US compared to 4 million studies in 1998. Considering the additional 2.8 million stress echocardiograms, the total number of stress imaging studies in the US was nearly 11 million in 2006. More importantly, one might measure patient selection, which is a key variable impacting directly on clinical management, downstream testing procedures, and—in particular—costs. Otero et al. [1] have shown that each test represents a cost and a risk, and that very small individual costs and risks become significant when multiplied by the large number of tests performed worldwide annually. This important concept has far-reaching implications. The cost of a medical imaging test has three different components: immediate cost; long-term cost (for instance, due to a new cancer developing decades after testing, as a

consequence of the imaging test); and a societal cost due to the possible environmental impact of the imaging procedure. The American College of Cardiology (ACC) and the subspecialty imaging societies have provided this quality issue by focusing on the development of appropriateness criteria for cardiovascular imaging which are designed to define the appropriate test for the appropriate indication in the appropriate patient [4]. According to recent estimates, at least one-third of all examinations are partially or totally inappropriate, i.e. risks and costs outweigh benefits. In a context of scarce resources, and consequently the need to optimize their allocation, economic evaluation could play an important role in establishing a cost-effective health care program and supporting the decisions of policymakers? The first appropriateness criteria were developed for SPECT myocardial perfusion imaging followed shortly thereafter with appropriateness criteria for echocardiography, cardiac computed tomography (CT), and cardiac magnetic resonance imaging (CMR) [5–16]. Both CMR and CT still have a lower profile in the economic market, but they are growing steadily [17–41]. CMR is currently not or not sufficiently reimbursed presumably because of limited evidence-based studies. It is not fully known whether CMR can be effectively used to facilitate medical decision-making and reduce costs by serving as a gatekeeper to invasive coronary angiography.

In the current issue of the *International Journal of Cardiovascular Imaging*, Pilz et al. [42] investigated

Editorial comment to the article of Pilz et al.
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whether the use of CMR in patients suspected for coronary artery disease (CAD) reduced costs by avoiding referrals to invasive procedures. Propensity score methods were used to match 218 patients from a CMR registry to a previously studied cohort in whom CMR was demonstrated to reliably identify patients who were at low-risk for major cardiac events. The proportion of patients was assessed for whom cardiac catheterization was deferred based on CMR findings. CMR reduced the utilization of cardiac catheterization by 62.4%. Based on estimated catheterization costs of € 619, the utilization of CMR as a gatekeeper reduced per-patient costs by a mean of € 90. CMR significantly reduced the utilization of cardiac catheterization in patients suspected of having CAD. Per-patient savings ranged from € 323 in patients at lowest risk of CAD to € 58 in patients at high-risk. Because a negative CMR study has a high negative predictive value, its use as a gatekeeper to cardiac catheterization is a worthwhile option in patients with suspected CAD who are considered for cardiac catheterization.

These findings are in line with previous noninvasive imaging studies which clearly showed a gatekeeper role for SPECT imaging in referral to invasive coronary arteriography [43, 44]. In the Economics of Noninvasive Diagnosis (END) study, Shaw et al. [43] compared two patient management strategies consisting of (1) direct cardiac catheterization (aggressive strategy), or (2) initial SPECT followed by selective catheterization of high risk patients (conservative strategy). The authors prospectively enrolled 11,372 consecutive stable angina patients who were referred for SPECT or cardiac catheterization. It was shown that stable chest pain patients who underwent a more aggressive diagnostic strategy had higher diagnostic costs and greater rates of intervention and follow-up costs. In the EMPIRE study, Underwood et al. [44] showed that investigative strategies using myocardial perfusion imaging were cheaper and equally effective when compared with strategies that did not use myocardial perfusion imaging, both for cost of diagnosis and for overall 2 year management costs. In an ongoing study, Groothuis et al. [45] combines multi-detector CT and CMR to provide the clinician a strategy with the aim to comprehensively evaluate coronary morphology and function noninvasively. In the MARCC trial (Magnetic Resonance and CT in suspected CAD)

a new noninvasive diagnostic work-up for patients with suspected CAD will be developed, involving the sequential use of both imaging techniques.

Although the results of the current study are still preliminary, Pilz et al. [42] have clearly shown that procedural costs in patients suspected for CAD would substantially decrease when CMR is routinely applied as a gatekeeper to cardiac catheterization.

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