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Clinical and economic impact of cardiac magnetic resonance-guided decision-making

Impacto clínico y económico de la toma de decisiones guiada por resonancia magnética cardiaca

To the Editor,

Cardiac magnetic resonance (CMR) is the gold standard for the study of myocardial function and viability. However, its costs and clinical usefulness as part of the patient's progress in a health care system with high care demands and limited economic resources remain to be established, particularly with the emergence of new management models for the technique.[1]

We carried out a retrospective, single-center, observational, intervention simulation study in patients who had undergone a CMR for clinical purposes between July 2014 and December 2017. After approval by the hospital ethics committee and following a previous methodology, we analyzed a random sample of 10% of the total activity performed during the inclusion period and obtained a representative sample.[2] We recorded the suspected diagnosis and investigations or interventions requested. The full CMR report was then sent to 2 consultants, and a new request was issued for the investigations or interventions that they considered necessary despite CMR. The cost analysis was based on the calculation of the total cost or saving generated as a result of the decisions made in the intervention simulation study. The reference prices used were those available in the Regional Health care System[3], or, if unavailable, the mean of the available prices in other regions was taken. All the prices were updated to euros with the 2020 value according to the Consumer Price Index. Lastly, we analyzed the mean radiation dose saved per patient after taking out the studies involving ionizing radiation.[4] The statistical analysis was performed with Stata Version 14.2 (StataCorp, USA). Continuous variables are expressed as mean ± standard deviation, and categorical variables as number and percentage.

In the period analyzed, 4046 CMRs were performed. A sample of 10% of these was taken, excluding those that were performed for research purposes, giving a final sample of 343 patients, with no differences in the baseline characteristics from the original population. CMR represented a significant change in diagnosis in 35.3% (121 patients) as a result of exclusion of the initial diagnosis in 88 patients (25.7%) and finding an unexpected diagnosis in 33 (9.6%).

Based on the clinical simulation analysis, the CMR result would have meant the end of the diagnostic process in 47.8% (164 patients), which represents a combined saving of 62.2% of the studies planned before CMR (table 1). Transthoracic echocardiography was the investigation with the greatest potential for reduction, up to 94.6% of studies (–229 studies). Furthermore, the use of CMR allowed a mean reduction of 1.54 mSv/patient attributable to the nonperformance of investigations or procedures involving ionizing radiation in the simulation. In the analysis of the

Table 1

Investigations performed before and after cardiac magnetic resonance report

Test/treatment	Before CMR	After CMR	Overall balance, No. (%)
Transthoracic echocardiogram	244	15	–229 (–94.6)
Transesophageal echocardiogram	30	12	–18 (–60)
SPECT	37	2	–35 (–95)
Cardiac catheterization	49	59	+10 (–20)
24-h Holter ECG	37	40	+3 (+8)
Coronary CT	42	10	–32 (–76)
Ergospirometry	57	52	–5 (–9)
Scintigraphy	6	0	–6 (–100)
ICD/ICD-CRT	21	19	–2 (–10)
Pacemaker-implantable Holter	1	2	+1 (+50)
Percutaneous coronary intervention	20	15	–5 (–25)
Surgical revascularization	7	5	–2 (–29)
Other cardiac surgery	9	13	+4 (+44)
Structural intervention	2	3	+1 (+50)
Ablation	15	13	–2 (–13)

CMR, cardiac magnetic resonance; CT, computed tomography; ICD, implantable cardioverter-defibrillator; ICD-CRT, implantable cardioverter-defibrillator and cardiac resynchronization therapy; Holter ECG, Holter electrocardiogram; SPECT, single photon emission computed tomography.

Table 2

Clinical usefulness and costs in the main indications for cardiac magnetic resonance

	Total	Cardiomyopathy	Aorta	Viability	Assessment of systolic function
Patients, No. (%)	343	95 (27.7)	48 (14.0)	45 (13.1)	40 (11.7)
CMR as last diagnostic test, %	47.8	31.6	70.8	60	40
Change in diagnosis, %	47.8	48.4	22.9	38.5	25
Change in treatment, %	17.8	17.9	4.2	48.9	42.5
Cost of change in diagnostic tests (€/patient)	−247.37	−144.69	−415.79	−313.26	−126.19
Cost of change in interventional treatment (€/patient)	+116.86	+74.37	+520.58	−2022.79	−862.56
Total cost* (€/patient)	+27.06	+320.98	+496.08	−1944.76	−597.45

CMR, cardiac magnetic resonance.

* The result for the total cost was obtained as follows: cost of diagnostic tests plus cost of CMR, from which we subtracted treatment savings due to the CMR results or added treatment costs due to the CMR results.

most prevalent indications in our sample (62% of the total; cardiomyopathy, aortic disease, myocardial viability, and ventricular function study), CMR allowed a change in diagnosis in 48% of the cardiomyopathy studies and a change in treatment in 42.5% of the ventricular function studies (table 2). Regarding aortic disease, only 4.2% of the patients had a change in treatment, as CMR is mainly indicated in the follow-up of aortic diseases that are not usually treated surgically.

The cost analysis from the simulation study for the whole sample showed a saving of €364.20 /patient (€247.40/patient from cancellation of diagnostic tests and €116.90/patients from changes in treatment); although after including the cost of performing a CMR (€391.30/study), the final balance showed a net expenditure of €27.06/patient (6.92% of the original cost of the CMR). In contrast, the subanalysis by indication showed an economic saving of €1944.76 and €579.45/patient when CMR was included for patients whose indication was myocardial viability study or systolic function study, respectively, due in large part to the cancellation of interventional procedures, surgery, or device implantation.

CMR is a key diagnostic instrument in contemporary cardiology; its main limitations are the high cost and problems with access to the technique. However, in our sample, CMR ended the diagnostic process in a high percentage of patients, reduced interventions and ionizing radiation dose, and reduced the financial costs for the health care system in some very common clinical indications. In this aspect, our results are similar to those published by Hedge et al.,[5] who retrospectively studied 361 patients in 2 centers, the main indications being heart failure and ischemic heart disease, and who found a saving of $2308/patient when CMR was included in the health care process, due to a reduction in invasive treatments.

Our study reveals the clinical and economic impact of the inclusion of CMR in the cardiology care process in the Spanish National Health System. The greatest impact was in patients whose CMR was requested for study of myocardial viability or systolic ventricular function.

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AUTHORS' CONTRIBUTIONS

M.E. Tundidor Sanz: data collection and analysis, manuscript writing. M. Barreiro Pérez: statistical analysis and manuscript writing. P. Luengo Mondéjar and M.J. García Sánchez: clinical simulation. F. Fernández-Vázquez and P.L. Sánchez Fernández: manuscript writing. All authors reviewed and approved the final version of the article.

CONFLICTS OF INTEREST

None.

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