European Heart Journal (2003) **24**, 789–800

ELSEVIER

EUROPEAN SOCIETY OF CARDIOLOGY

Review article

Noninvasive evaluation of ischaemic heart disease: myocardial perfusion imaging or stress echocardiography?

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Received 3 July 2002; revised 27 August 2002; accepted 28 August 2002

Introduction

Stress echocardiography and myocardial perfusion imaging are commonly used noninvasive imaging modalities for the evaluation of ischaemic heart disease. Both modalities have proved clinically useful in the entire spectrum of coronary artery disease.[1–29] Both techniques can detect coronary artery disease and provide prognostic information.[1–21] Both techniques can identify low-risk and high-risk subsets among patients with known or suspected coronary artery disease and thus guide patient management decisions.[18–21] In patients with acute myocardial infarction, both techniques have been used to identify residual viable tissue and predict improvement of function over time.[22–26] In patients with chronic ischaemic left ventricular (LV) dysfunction, viability assessment with either modality can be used to predict improvement of function after revascularisation and thus guide patient treatment.[27–29]

Hence, the use of noninvasive cardiac imaging can help guide management and potentially reduce healthcare costs.[30] The question remains what is the optimal noninvasive cardiac imaging method in which setting? This article evaluates the value of the two modalities in: (1) the detection of coronary artery disease, (2) the prognosis of coronary artery disease in patients with known or suspected coronary artery disease, (3) prediction of functional recovery following acute myocardial infarction and (4) prediction of functional recovery after revascularisation in patients with chronic ischaemic LV dysfunction. To provide the most objective information, only direct comparative studies on stress echocardiography and perfusion imaging in the same patients are included and pooled analysis of the data was performed.

Methods

The available studies were identified by MEDLINE searches using the following key words: noninvasive imaging, stress echocardiography, dobutamine, dipyridamole, adenosine, myocardial perfusion imaging, technetium-99m sestamibi, technetium-99m tetrofosmin and thallium-201. In addition, a manual search of eight cardiology and nuclear medicine journals (American Heart Journal, American Journal of Cardiology, Circulation, European Heart Journal, Heart, Journal of the American College of Cardiology, Journal of Nuclear Cardiology, Journal of Nuclear Medicine) from January 1975 to 2001 was carried out. Only studies that performed a head-to-head comparison between stress echocardiography and some form of nuclear imaging were selected. From these articles the sensitivity and specificity of the techniques were compared. Studies that did not provide this information were excluded. From the pooled data,

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doi:10.1016/S0195-668X(02)00634-6

weighted sensitivities and specificities were calculated. Comparison of sensitivities and specificities was performed using McNemar testing; a *P*-value <0.05 was considered significant.

Results

Detection of coronary artery disease

Seventeen direct comparisons (1405 patients) with different stressors (five exercise, two adenosine, one dipyridamole, eight dobutamine, and one combined adenosine and dobutamine) were identified (Table 1). Pooling of the data showed a slightly higher overall sensitivity for myocardial perfusion imaging as compared to stress echocardiography (84 vs 80%, $P<0.05$). This finding is in line with the ischaemic cascade (Fig. 1), since perfusion abnormalities (detected by perfusion imaging) proceed systolic dysfunction (detected by stress echocardiography).[31]

On the other hand, stress echocardiography was more specific compared to perfusion imaging (86 vs 77%, $P=0.001$). Fig. 2 demonstrates the differences in sensitivity and specificity of the two modalities. It should be noted that the gold standard for the presence/absence of coronary artery disease was angiography in these studies, which may affect specificity of the tests. In the majority of the studies ≥50% stenosis was used as the definition of significant coronary artery disease. In the study of Marwick et al.,[9] results were also analysed with a cutoff of >70% stenosis. The results were altered little using this cutoff, as only four patients had a stenosis severity of 50–70%.

Pharmacological stress can be a useful alternative to exercise stress protocols in patients who are unable to exercise because of neurological, orthopedic, or peripheral vascular disease. Because wall motion abnormalities are a consequence of myocardial ischaemia, dobutamine may be more effective than vasodilator (adenosine or dipyridamole) stress echocardiography.[32] In line with this, combined data from seven direct comparative studies demonstrated that dobutamine stress echocardiography had a higher sensitivity for the diagnosis of coronary artery disease than vasodilator stress echocardiography, while specificity was similar. When dobutamine stress echocardiography was compared to dobutamine or vasodilator perfusion scintigraphy, dobutamine echocardiography was equally sensitive but slightly more specific than perfusion scintigraphy.[33]

Two subgroups of patients were analysed separately: hypertensive patients and female patients. In patients with hypertension, abnormal thallium perfusion results have been demonstrated in the absence of obstructive coronary artery disease;[34,35] this may lower specificity. Summarised data from two studies (Table 2, 286 patients) have demonstrated a somewhat higher sensitivity for perfusion imaging compared to stress echocardiography (87 vs 74%, $P<0.005$), and confirmed the lower specificity for perfusion imaging (44 vs 85%, $P<0.001$).[36,37]

The diagnosis of coronary artery disease in women may be more challenging due to the lower prevalence of coronary artery disease. In addition, single-vessel disease is a common finding in women.[38,39] The accuracy of perfusion imaging appears to be decreased in women with breast tissue attenuation,[39] and the smaller LV chamber size in women.[40] Pooled data from three direct comparisons[41–43] revealed a comparable sensitivity of the two techniques (71 vs 80%, $P=$ns) (175 patients, Table 2) with a higher specificity of stress echocardiography for the detection of coronary artery disease (72 vs 89%, $P<0.01$). Comparative studies on adenosine stress imaging in patients with hypertension and women are not available. Further research on the relative value of adenosine stress echocardiography and nuclear perfusion imaging in these subgroups is needed.

Prognosis in coronary artery disease

Noninvasive cardiac imaging is frequently used for risk stratification of patients with known or suspected coronary artery disease. There are two direct comparisons available on the prognostic value of myocardial perfusion imaging and stress echocardiography. Geleijnse et al.[18] studied 220 patients with chest pain with dobutamine–atropine stress echocardiography and simultaneous technetium-99m sestamibi single photon emission computed tomography (SPECT) imaging. During follow-up of 31±15 months, 24 patients had hard cardiac events (nonfatal myocardial infarction or cardiac death). A normal test was related to a good prognosis, with a low annual cardiac event rate of 0.4% by echocardiography and 0.5% by perfusion imaging. In that study, stress echocardiography and technetium-99m sestamibi SPECT provided comparable prognostic information.

Olmos et al.[19] studied 248 patients who underwent exercise echocardiography simultaneously with thallium-201 SPECT. During follow-up (obtained in 225 patients with a mean follow-up of 3.7±2.0 years), 64 cardiac events occurred (eight nonfatal infarctions and seven cardiac deaths). A significant difference was observed between

Table 1 Myocardial perfusion imaging vs stress echocardiography in the diagnosis of coronary artery disease

Author	Year	Pts	Definition of significant CAD	Stress	Tracer	Sensitivity		Specificity	
						MPI	Echocardiography	MPI	Echocardiography
Maurer[1]	1981	36	≥50% stenosis	Exercise	Tl-201	74% (17/23)	83% (19/23)	92% (12/13)	92% (12/13)
Nguyen[2]	1990	25	≥50% stenosis	Adenosine	Tl-201	90% (18/20)	60% (12/20)	100% (5/5)	100% (5/5)
Galanti[3]	1991	53	≥70% stenosis	Exercise	Tl-201	100% (27/27)	53% (25/27)	92% (24/26)	96% (25/26)
Pozzoli[4]	1991	75	≥50% stenosis	Exercise	Tc-99m	84% (41/49)	71% (35/49)	88% (23/26)	96% (25/26)
Quinones[5]	1992	112	≥50% stenosis	Exercise	Tl-201	76% (65/86)	74% (64/86)	81% (21/26)	88% (23/26)
Salustri[6]	1992	44	≥50% stenosis	Exercise	Tc-99m	77% (23/30)	67% (20/30)	86% (12/14)	71% (10/14)
Gunalp[7]	1993	27	≥50% stenosis	Dobutamine	Tc-99m	94% (17/18)	83% (15/18)	88% (8/9)	88% (8/9)
Amanullah[8]	1993	40	≥50% stenosis	Adenosine	Tc-99m	94% (32/34)	74% (25/34)	100% (6/6)	100% (6/6)
Marwick[9]	1993	97	≥50% stenosis	Adenosine	Tc-99m	86% (51/59)	58% (34/59)	71% (27/38)	87% (33/38)
Marwick[9]	1993	97	≥50% stenosis	Dobutamine	Tc-99m	80% (47/59)	85% (50/59)	74% (28/38)	82% (31/38)
Marwick[10]	1993	217	≥50% stenosis	Dobutamine	Tc-99m	76% (108/142)	72% (102/142)	67% (50/75)	83% (62/75)
Forster[11]	1993	21	≥50% stenosis	Dobutamine	Tc-99m	83% (10/12)	75% (9/12)	89% (8/9)	89% (8/9)
Senior[12]	1994	61	≥50% stenosis	Dobutamine	Tc-99m	95% (42/44)	93% (41/44)	71% (12/17)	94% (16/17)
Ho[13]	1995	54	≥50% stenosis	Dobutamine	Tl-201	98% (42/43)	93% (40/43)	73% (8/11)	73% (8/11)
Kisacik[14]	1996	69	≥50% stenosis	Dobutamine	Tc-99m	96% (45/47)	94% (44/47)	64% (14/22)	86% (19/22)
Huang[15]	1997	93	≥50% stenosis	Dobutamine	Tl-201	90% (60/67)	93% (62/67)	81% (21/26)	77% (20/26)
Parodi[16]	1999	101	≥50% stenosis	Dipyridamole	Tc-99m	79% (63/80)	78% (62/80)	90% (19/21)	76% (16/21)
Smart[17]	2000	183	≥50% stenosis	Dobutamine	Tc-99m	80% (95/119)	87% (104/119)	73% (47/64)	91% (58/64)
Pooled analysis						84% (803/959)	80% (765/959)	77% (345/446)	86% (385/446)

MPI=myocardial perfusion imaging; Tc-99m=Technetium-99m; Tl-201=Thallium-201 chloride.

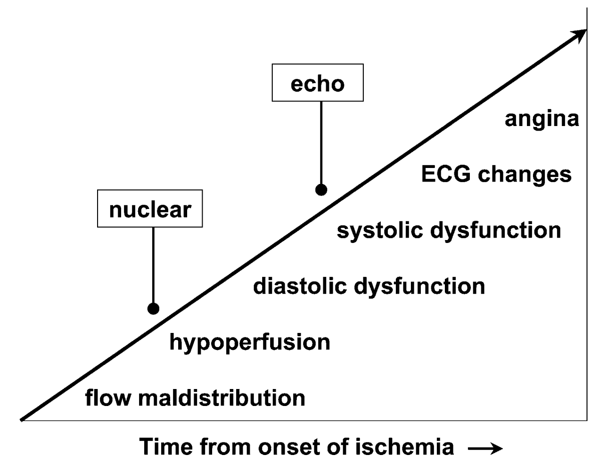

Fig. 1 The ischaemic cascade represents a sequence of pathophysiologic events caused by coronary artery disease. Nuclear imaging probes an earlier event (hypo-perfusion) in the ischaemic cascade than stress echocardiography does (systolic dysfunction).

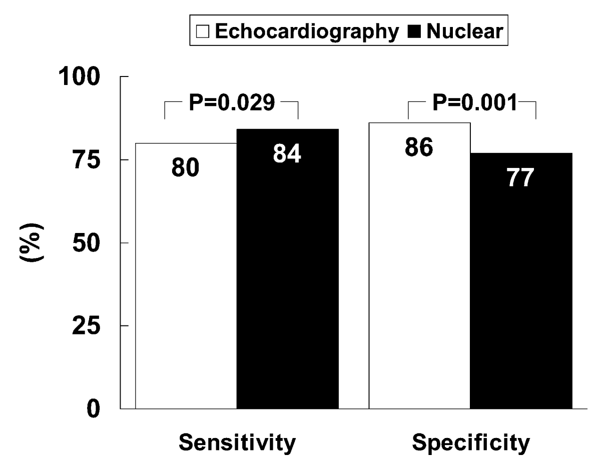

Fig. 2 Sensitivity and specificity of stress echocardiography and nuclear imaging for the detection of coronary artery disease (data based on Refs. 1–17). □=echocardiography; ■=nuclear.

patients with normal and abnormal tests for all end points, including death alone, for both modalities. Overall cardiac event rate in patients with normal test results was comparable for both exercise echocardiography and thallium-201 SPECT (1.05 vs 1.13%, ns). Annual cardiac death rate was favorably low for both normal echocardiography and normal SPECT imaging (0.08 vs 0.08%, ns). Since only two direct comparisons are available, more large studies are required to fully elucidate the relative prognostic value of myocardial perfusion imaging and stress echocardiography.

Assessment of myocardial viability

The hallmark of viability on dobutamine echocardiography is the improvement of wall motion during the infusion of low-dose dobutamine (5–10 μg kg^{-1} min^{-1}). More recent studies have employed a low-high dose protocol (with dosages up to 40 μg kg^{-1} min^{-1}, with the addition of atropine). This protocol allows assessment of both viability (response during low-dose dobutamine) and stress-induced ischaemia (response during high-dose dobutamine). For nuclear imaging, different techniques are available. Thallium-201 imaging can be used to evaluate perfusion and cell membrane integrity. Two protocols are used mainly: rest-redistribution imaging and stress-redistribution-reinjection imaging.[27–29] While rest-redistribution imaging provides only information on myocardial viability, the reinjection protocol allows assessment of stress-induced ischaemia and viability.

Technetium-99m sestamibi can be used to assess perfusion and intact mitochondria. Sestamibi imaging is performed under resting conditions; in the absence of a stress study, this protocol only provides information on viability. It has been demonstrated that the addition of nitrates before tracer administration enhances viability detection.[44]

Glucose utilisation can be evaluated with F18-fluorodeoxyglucose (FDG). FDG imaging can nowadays be performed with positron emission tomography and SPECT. The introduction of SPECT imaging has contributed to a more widespread use of FDG.[45] Generally, cardiac FDG uptake is compared with regional perfusion. Viability is defined when perfusion/FDG uptake is normal, or when perfusion is reduced with enhanced FDG uptake.

Prediction of functional recovery after acute myocardial infarction

The phenomenon of reversible dysfunction after myocardial infarction, known as stunning has been well established.[46,47] The presence of viable, but stunned myocardium has been used to predict functional recovery. Five studies[22–26] with 209 patients and 958 dyssynergic myocardial segments, compared perfusion imaging with stress echocardiography in the same patient population after acute myocardial infarction and aimed at the prediction of recovery of function (Table 3). All of these studies used dobutamine stress, in most studies a low-dose dobutamine protocol was employed for echocardiography. Nuclear imaging tended to have a higher sensitivity (although not significant),

Table 2 Myocardial perfusion imaging vs stress echocardiography in special patient subsets

Author	Year	Pts	Definition of significant CAD	Stress	Tracer	Sensitivity		Specificity	
						MPI	Echo-cardiography	MPI	Echo-cardiography
Hypertension									
Elhendy[36]	1998	84	≥50% stenosis	Dobutamine	Tc-99m	67% (44/66)	73% (48/66)	83% (15/18)	83% (15/18)
Fragasso[37]	1999	101	≥50% stenosis	Dipyridamole	Tc-99m	98% (56/57)	61% (35/57)	36% (16/44)	91% (40/44)
Fragasso[37]	1999	101	≥50% stenosis	Dobutamine	Tc-99m	98% (56/57)	88% (50/57)	36% (16/44)	80% (35/44)
Pooled analysis						87% (156/180)	74% (133/180)	44% (47/106)	85% (90/106)
Women									
Takeuchi[41]	1996	61	≥50% stenosis	Dobutamine	Tl-201	78% (14/18)	72% (13/18)	70% (30/43)	91% (39/43)
Elhendy[42]	1998	70	≥50% stenosis	Dobutamine	Tc-99m	64% (29/45)	78% (35/45)	72% (18/25)	92% (23/25)
Ho[43]	1998	44	≥50% stenosis	Dobutamine	Tl-201	79% (19/24)	92% (22/24)	75% (15/20)	80% (16/20)
Pooled analysis						71% (62/87)	80% (70/87)	72% (63/88)	89% (78/88)

MPI=myocardial perfusion imaging; Tc-99m=Technetium-99m; Tl-201=Thallium-201 chloride.

Table 3 Prediction of recovery of function after acute myocardial infarction: myocardial perfusion imaging vs stress echocardiography

Author	Year	Pts	Dyssynergic segments	Techniques	Sensitivity		Specificity	
					MPI	Echocardiography	MPI	Echocardiography
Elhendy[22]	1996	32	112	Tl-201 RR vs LDDE	77% (27/35)	77% (27/35)	57% (44/77)	84% (65/77)
Le Feuvre[23]	1996	45	235	Tl-201 RI vs LDDE	54% (59/109)	53% (58/109)	88% (111/126)	95% (120/126)
Smart[24]	1997	64	399	Tl-201 RR vs HDDE	68% (140/207)	88% (183/207)	70% (134/192)	80% (153/192)
Spinelli[25]	1999	49	108	Tl-201 vs LDDE	87% (53/61)	66% (40/61)	74% (35/47)	89% (42/47)
Anselmi[26]	2000	19	104	Tl-201 RR vs LDDE	88% (23/26)	69% (18/26)	36% (28/78)	88% (69/78)
Pooled analysis					69% (302/438)	74% (326/438)	68% (352/520)	86% (449/520)

HDDE=low-high dose dobutamine echocardiography; LDDE=low-dose dobutamine echocardiography; MPI=myocardial perfusion imaging; RI=reinjection; RR=rest-redistribution; Tl-201=thallium-201 chloride.

whereas stress echocardiography was more specific in the prediction of recovery of function (Fig. 3).

Prediction of functional recovery after revascularisation in chronic ischaemic LV dysfunction

Table 4 shows the accuracy of different viability techniques for the prediction of improvement of function after revascularisation.[29] The nuclear imaging techniques appear to have a higher sensitivity for the prediction of functional recovery whereas stress echocardiography appears more specific. Various studies have directly compared some form of nuclear imaging to stress echocardiography. Panza et al.[48] have performed a head-to-head comparison between thallium-201 imaging and dobutamine stress echocardiography in patients with chronic ischaemic LV dysfunction. A total of 311 segments were analysed by both techniques; 84% of these were classified as viable and 16% as nonviable on thallium-201 imaging. The majority of the 'thallium-201 nonviable segments' did not exhibit contractile reserve. However, an additional 36% of the 'thallium-201 viable segments' also did not exhibit contractile reserve. Thus, the results indicated that thallium-201 imaging was more sensitive than dobutamine echocardiography for the detection of viable tissue. Similar results were obtained by Cornel et al.[49] who evaluated 40 patients with chronic ischaemic LV dysfunction with FDG imaging and dobutamine echocardiography. Again, nuclear imaging was more sensitive for the detection of viable tissue as

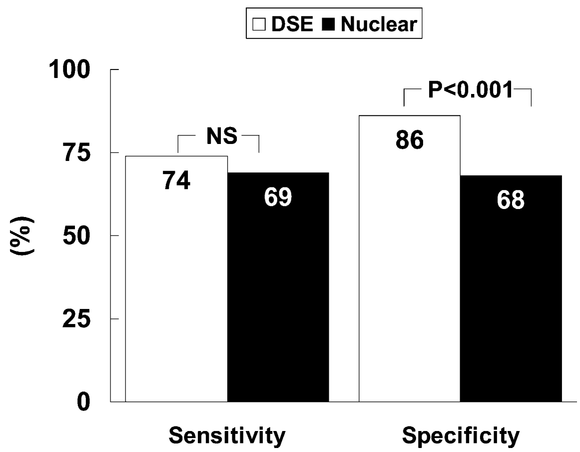

Fig. 3 Sensitivity and specificity of dobutamine stress echocardiography and nuclear imaging for the prediction of functional outcome in acute myocardial infarction (data based on Refs. 22–26). □=DSE; ■=nuclear.

evidenced by the 27% of the dysfunctional segments with FDG uptake but without contractile reserve (Fig. 4).

Various studies have subsequently compared the predictive accuracy of nuclear imaging with dobutamine echocardiography. Currently, a total of 18 studies[50–67] (with 563 patients) have performed a direct comparison between the two modalities (Table 5). Different nuclear techniques were used: three studies used FDG PET, five thallium-201 reinjection and 10 thallium-201 rest-redistribution. Two studies used low-high dose dobutamine echocardiography and the remaining 16 used low-dose dobutamine echocardiography. Pooling of these data yielded a higher sensitivity for nuclear imaging (88 vs 76%, $P<0.05$) and a higher specificity for dobutamine echocardiography (81 vs 53%, $P<0.05$). In eight studies (see Table 5), some form of stress imaging (either thallium-201 reinjection or low-high dose dobutamine echocardiography) was used; to make the comparison more balanced (and only restricted to viability assessment) the analysis was repeated after exclusion of these eight studies. The discrepancy between nuclear imaging and dobutamine echocardiography for the prediction of functional outcome after revascularisation became even more outspoken (Fig. 5).

It is conceivable that different levels of ultrastructural cell damage account for this discrepancy: the inotropic response during dobutamine stimulation may be lost while more basal characteristics such as cell membrane integrity and glucose utilisation are still intact. Besides prediction of improvement of function after revascularisation, prediction of long-term survival may be more important. Currently, no direct comparative studies are available on the prognostic value of nuclear imaging and stress echocardiography in patients with ischaemic cardiomyopathy.

Recent developments: simultaneous assessment of function and perfusion

Recently, different technical developments have been implemented in both perfusion imaging and stress echocardiography that further optimised the techniques. Myocardial perfusion imaging has been improved by the introduction of new cameras, imaging protocols, attenuation and scatter correction.[68,69] For echocardiography, second harmonic imaging has markedly improved endocardial border detection, which could even be further enhanced by intravenous administration of contrast agents that opacify the LV cavity.[70–72] Colour kinesis and tissue Doppler echocardiography may allow quantification of function,[73,74] which may enhance reproducibility and diagnostic accuracy.

Other recent developments have aimed at providing integrated information on function and perfusion. Both gated SPECT imaging and contrast echocardiography allow simultaneous assessment of function and perfusion.[75,76] Over the past 5 years ECG-gated SPECT has become state-of-the-art in cardiac myocardial perfusion imaging. Various comparative studies have demonstrated excellent accuracy of gated SPECT for the assessment of both regional and global LV function.[77] Smanio et al.[78] have demonstrated that combination of perfusion and function (assessed by gating) resulted in significantly higher diagnostic accuracy for detection/exclusion of coronary artery disease. Moreover, the integrated information of function and perfusion allows superior prognostification in patients with known or suspected coronary artery disease, as demonstrated recently by Sharir et al.[79]

Contrast echocardiography also allows simultaneous assessment of function and perfusion. With the introduction of contrast agents that can be administered intravenously, the use of contrast echocardiography has now become feasible outside the catheterisation laboratory. In combination with harmonic and intermittent imaging, quantitative assessment of perfusion has become possible.

Recently, Kaul et al.[80] have shown an excellent concordance between contrast echocardiography and myocardial perfusion imaging. In 30 patients, the agreement for detecting absence/presence of coronary artery disease was 86%. However, two multicentre trials have demonstrated a less favourable agreement between perfusion imaging and

Table 4 Accuracy of the different viability techniques (data based on pooled analysis of data available in the literature[29])

Technique	No. of studies	No. of pts	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
DSE	32	1090	81	80	77	85
Tl-201 RR	22	557	86	59	69	80
Tl-201 RI	11	301	88	50	57	83
MIBI	20	488	81	66	71	77
FDG PET	20	598	93	58	71	86

DSE=dobutamine stress echocardiography; FDG=F18-fluorodeoxyglucose; MIBI=technetium-99m sestamibi; NPV=negative predictive value; PET=positron emission tomography; PPV=positive predictive value; RR=rest-redistribution; RI=reinjection; Tl-201=thallium-201 chloride.

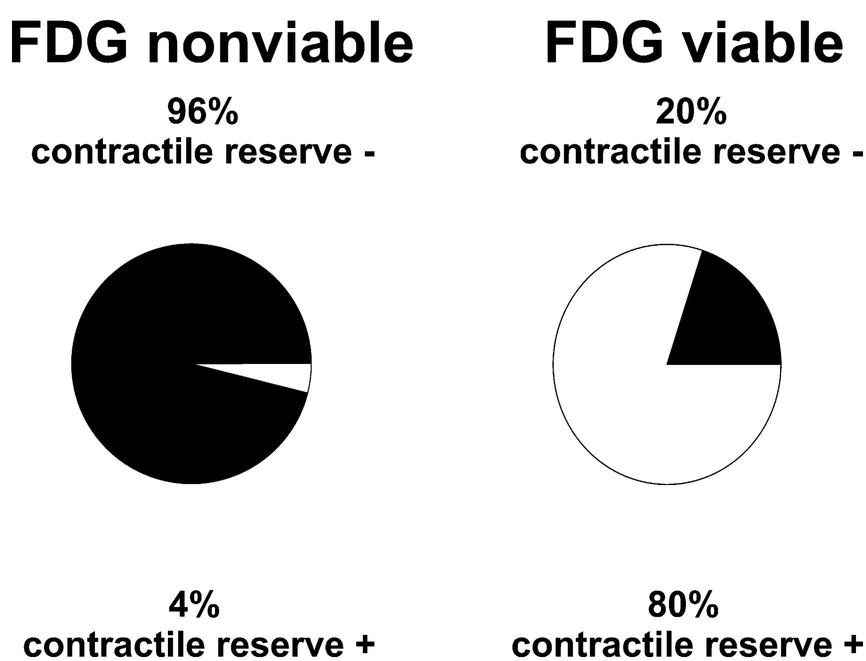

Fig. 4 Agreement and disagreement between FDG SPECT and low-dose dobutamine echocardiography in dysfunctional myocardium (reprinted with permission from Cornel et al.[49]).

contrast echocardiography.[81,82] Marwick et al.[81] showed that, for the detection of extensive perfusion defects on SPECT perfusion imaging, contrast echocardiography had a sensitivity ranging from 13 to 48% with a specificity ranging from 63 to 100%. Jucquois et al.[82] suggested that the discrepancy between the two techniques could in part be related to attenuation artifacts on SPECT (inferior wall) and suboptimal visualisation of the anterior and lateral walls by echocardiography. However, in experienced settings, adequate quantification of myocardial blood flow and quantification of coronary artery stenoses is possible, as demonstrated by Wei and colleagues.[83,84] Besides detection of coronary artery disease, evaluation of patients with acute myocardial infarction is feasible with contrast echocardiography and is particularly useful for assessment of 'the no-reflow phenomenon' after thrombolysis or percutaneous interventions.[85,86] Finally, the feasibility of contrast echocardiography for assessment of viability after acute infarction[87] and in the setting of chronic LV dysfunction[88] has been demonstrated.

Thus, in the near future, the combined assessment of perfusion and function by echocardiography and SPECT will allow a more complete assessment of patients with coronary artery disease.

Clinical implications and conclusions

Both myocardial perfusion imaging and stress echocardiography have proved to be extremely useful noninvasive tests for the evaluation of coronary artery disease.[1–29] Due to basic differences between the two tests, perfusion imaging is a sensitive test with a somewhat lower specificity

Table 5 Head-to-head comparisons between nuclear imaging and dobutamine echocardiography for the prediction of improvement of regional function post-revascularisation (table modified from Ref. 29)

Author	Techniques	Assessing	No. of pts
Gerber[50]	FDG PET vs LDDE	V vs V	39
Baer[51]	FDG PET vs LDDE	V vs V	42
Pagano[52]	FDG PET vs LDDE	V vs V	30
Vanoverschelde[53]	Tl-201 RI vs LDDE	V+I vs V	73
Arnese[54]	Tl-201 RI vs LDDE	V+I vs V	38
Bax[55]	Tl-201 RI vs LDDE	V+I vs V	17
Haque[56]	Tl-201 RI vs LDDE	V+I vs V	26
Kostopoulos[57]	Tl-201 RI vs LDDE	V+I vs V	31
Marzullo[58]	Tl-201 RR vs LDDE	V vs V	14
Qureshi[59]	Tl-201 RR vs HDDE	V vs V+I	34
Alfieri[60]	Tl-201 RR vs LDDE	V vs V	13
Perrrone-Filardi[61]	Tl-201 RR vs LDDE	VvsV	18
Charney[62]	Tl-201 RR vs LDDE	V vs V	14
Nagueh[63]	Tl-201 RR vs HDDE	V vs V+I	19
Pace[64]	Tl-201 RR vs LDDE	V vs V	46
Senior[65]	Tl-201 RR vs LDDE	V vs V	22
Sicari[66]	Tl-201 RR vs LDDE	V vs V	57
Gunning[67]	Tl-201 RR vs LDDE	V vs V	30

FDG=F 18-fluorodeoxyglucose; HDDE=low-high dose dobutamine echocardiography; I=stress-inducible ischaemia; LDDE=low-dose dobutamine echocardiography; PET=positron emission tomography; RI=reinjection; RR=rest-redistribution; Tl-201=thallium-201 chloride; V=viability.

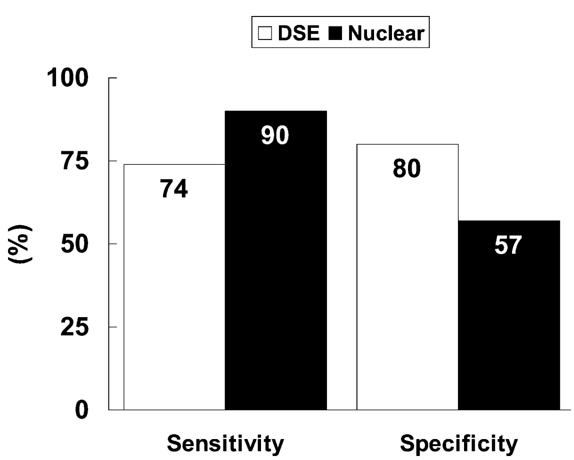

Fig. 5 Bar graph illustrating sensitivities and specificities of nuclear imaging and dobutamine stress echocardiography to predict improvement of function post-revascularisation in patients with chronic ischaemic left ventricular dysfunction (data based on Refs. 50–52,58,60–62). □=DSE; ■=nuclear.

for the detection of coronary artery disease; the converse is true for stress echocardiography.[1–17] This systematic review focuses on direct comparative studies on stress echocardiography and perfusion imaging in order to provide the most objective information. Nevertheless, a potential risk of pooling data from different studies is to mix patients with different clinical characteristics and risk profile.

Two available direct head-to-head comparative studies demonstrated a similar prognostic value of perfusion imaging and stress echocardiography. Larger comparisons are needed to draw further conclusions.

For the assessment of myocardial viability after acute infarction the modalities seem to be equally sensitive, whereas stress echocardiography is the more specific test.[22–26] Hence, for the early assessment of viability stress echocardiography may be preferable. However, specificity is determined by segments that are nonviable that do not improve in function. A lower specificity suggests that a substantial percentage of segments that are viable do not recover in function. Most studies have evaluated recovery of function at a rather short time-interval after infarction (<3 months) and longer follow-up may be needed.

In patients with chronic ischaemic ventricular dysfunction, nuclear imaging has a high sensitivity for the detection of viable myocardium and a low specificity, whereas the converse is true for stress echocardiography.[50–67] The lower specificity of nuclear imaging can again be an issue of duration of follow-up. Recent data have demonstrated that a substantial percentage of segments need longer time after revascularisation to (fully) recover in function.[89] In addition, large direct comparative studies are required to evaluate the prognostic value of nuclear imaging and stress echocardiography in patients with chronic ischaemic left ventricular dysfunction.

In conclusion, the current analysis demonstrated that both techniques are useful in the evaluation of patients with coronary artery disease, although small differences between accuracies exist in different settings. The most important factor for using a test remains the local expertise and availability of these imaging modalities. In addition, patient characteristics (habitus, acoustic window, pregnancy) may influence the choice of the technique, and finally the studies discussed generally reflect the experience in university centers and many of these studies may be influenced by selection and referral bias, which limits application of the results to the general population.

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