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CLINICAL RESEARCH

Relationship between location and size of myocardial infarction and their reciprocal influences on post-infarction left ventricular remodelling

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Aims To assess the intricate relationship between myocardial infarction (MI) location and size and their reciprocal influences on post-infarction left ventricular (LV) remodelling.

Methods and results A cohort of 260 reperfused ST-segment elevation MI patients was prospectively studied with cardiovascular magnetic resonance at 1 week (baseline) and 4 months (follow-up). Area at risk (AAR) and MI size were quantified by T2-weighted and late-gadolinium enhancement imaging, respectively. Adverse LV remodelling was defined as an increase in LV end-systolic volume $\geq$15% at follow-up. One hundred and twenty-seven (49%) patients had anterior MI and 133 (51%) patients had non-anterior MI. Although the degree of myocardial salvage was similar between groups ($P = 0.74$), anterior MI patients had larger AAR and MI size than non-anterior MI patients yielding worse regional and global LV function at baseline and follow-up. At univariable analysis, anterior MI was associated with increased risk of adverse LV remodelling ($P = 0.017$) and lower LV ejection fraction (EF) at follow-up ($P = 0.001$), but not when accounted for baseline MI size. Accordingly, at multivariable analysis, baseline MI size but not its location was an independent predictor of adverse LV remodelling (odds ratio = 1.061, $P < 0.001$) and EF at follow-up (β-coefficient = -0.255, $P < 0.001$).

Conclusion Anterior MI patients experience more pronounced post-infarction LV remodelling and dysfunction than non-anterior MI patients due to a greater magnitude of irreversible ischaemic LV damage without any independent contribution of MI location.

Keywords Myocardial infarction • Cardiovascular magnetic resonance

Introduction

Effective risk stratification is crucial for the management of patients with acute ST-segment elevation myocardial infarction (MI). Previous studies showed that patients with acute anterior MI experienced more pronounced adverse left ventricular (LV) remodelling and, thereby, had worse prognosis than non-anterior MI patients.[1–5] Accordingly, the anterior location of MI has been included in risk assessment algorithms for prognosis prediction of patients after acute ST-segment elevation MI.[4,5] However, it is still disputable whether the worse post-infarction LV remodelling and prognosis associated with anterior MI is due to greater MI

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size or whether infarct location exerts a role further than MI size.[6,7] Several authors advocated an independent contribution of infarct location based on the fact that anterior MI patients had similar cardiac enzyme release but worse post-infarction LV remodelling and prognosis compared with non-anterior MI patients.[1,2] However, these results were questioned by those of other studies,[8–10] showing larger MI size in anterior than non-anterior infarcts. These conflicting findings can be primarily ascribed to the lack of a means to precisely quantify LV damage.

Cardiovascular magnetic resonance (CMR) allows an accurate determination of acute and chronic MI size by the late-gadolinium enhancement (LGE) technique.[11] Early post-infarction T2-weighted CMR enables to quantify the area at risk (AAR),[12,13] and the amount of salvaged myocardium can be derived combining T2-weighted and LGE imaging.[14] We sought to evaluate the relationship between the location and size of MI and their reciprocal influence on post-infarction LV remodelling by studying a cohort of patients with reperfused ST-segment elevation MI using a comprehensive CMR approach.

Methods

Study population

Between May 2006 and January 2009, 297 consecutive acute ST-segment elevation MI patients from three tertiary referral centres [156 at UZ Leuven, Leuven, Belgium (Centre A), 73 at La Sapienza University Hospital, Rome, Italy (Centre B), and 68 at Fondazione G. Monasterio, Pisa, Italy (Centre C)] were prospectively studied by CMR at 1 week (baseline) and 4 months (follow-up) after MI. Inclusion criteria were: (i) chest pain suggestive of myocardial ischaemia lasting >30 min but <12 h; (ii) ECG showing ST-segment elevation >0.1 mV in two or more limb leads or >0.2 mV in two or more contiguous precordial leads, or presumed new left bundle branch block; and (iii) treatment with percutaneous coronary intervention (PCI) within 12 h from symptoms onset. Exclusion criteria were: prior MI or revascularization, atrial fibrillation, cardiogenic shock, renal failure (plasma creatinine >2 mg/dL) and claustrophobia. The study complied with the Declaration of Helsinki. Local ethic review boards approved the protocol, and written informed consent was obtained from each patient.

Cardiovascular magnetic resonance protocol

Cardiovascular magnetic resonance studies were performed at centre A with 1.5 T unit (Intera-CV, Philips, Best, The Netherlands), at centre B with 1.5 T unit (Avanto-Siemens, Erlangen, Germany), and at centre C with 1.5 T unit (CVi-GE Healthcare, Milwaukee, WI, USA). All studies were performed using dedicated cardiac software, phased-array surface receiver coil, and electrocardiogram triggering. A similar CMR study protocol was followed in all centres (see Supplementary material online, Appendix). Breath-hold steady-state free-precession cine CMR was performed in cardiac vertical and horizontal long-axis and in short-axis orientation. In cardiac short axis, both ventricles were completely encompassed by a stack of contiguous slices. Next, AAR was determined using breath-hold black-blood T2-weighted short inversion-time inversion-recovery fast spin-echo sequence in cardiac short axis. Post-contrast breath-hold T1-weighted two-dimensional (Avanto-Siemens/CVi, GE Healthcare) or three-dimensional (Intera-CV, Philips) inversion-recovery segmented gradient-echo sequence was used to detect microvascular obstruction (MO) and myocardial necrosis/fibrosis. An intravenous contrast agent dose of 0.1 mmol/kg of Gadolinium-BOPTA (Multihance, Bracco, Milan, Italy) or 0.2 mmol/kg Gadolinium-DOTA (Dotarem, Guerbet, France) was used. Early and late post-contrast imaging were performed 2–5 and 10–20 min following contrast administration to assess the presence of MO and myocardial necrosis/fibrosis, respectively. Inversion time was individually adapted to nullify signal of remote myocardium. At follow-up, the same CMR protocol was used with exception for T2-weigthed imaging.

Image analysis

All CMR studies were stored in DICOM format and centrally analysed in the centre A using in-house developed cardiac vendor-independent software (CardioViewer) by consensus of two experienced observers, unaware of clinical and angiographic data. Analysis was started by scoring T2-weighted imaging quality using a four-grade score: (1) poor, (2) moderate, (3) good, and (4) excellent. Only exams scored >1 were considered for further analysis. Extent of AAR was determined using a semi-automatic approach. On T2-weighted images, AAR was automatically identified as the myocardium with signal intensity (SI) >2SD above mean SI of remote myocardium.[14] Then, AAR borders were manually adapted to exclude the hyperintense region at endocardial boundary (slow-flow artefact) or to include, when present, the hypointense region within the hyperintense myocardium (haemorrhagic component). Extent of AAR was expressed as LV percentage. On early post-contrast imaging, MO was defined as the hypoenhanced region within the hyperintense myocardium. On late post-contrast imaging, LV LGE was automatically identified as the myocardium with SI >5SD mean SI of remote myocardium.[15] Then, LGE contours were manually adapted to include MO, when present. Infarct transmurality was computed by dividing LGE area by the total area of the corresponding myocardial wall and expressed as percentage. Myocardial salvage index (MSI) was defined as the difference between AAR extent and baseline MI size divided AAR extent.[14] Left ventricle was segmented based on the 17-segment model according to the AHA recommendation,[16] segment 17 was not further considered. Infarct location was assigned according to the location of the hyperintense myocardium on baseline LGE or T2-weighted imaging. On short-axis images, a segment was considered involved when the hyperintense myocardium occupied >50% of its circumferential extent. Infarction was defined as anterior when at least one of the following segments was involved: basal anteroseptal, mid-anterior, mid-anteroseptal, or apical anterior segment.[17]

Cine CMR was used to derive LV end-diastolic (EDV) and end-systolic (ESV) volumes, ejection fraction (EF), regional wall motion, and LV mass. Regional wall motion per segment was scored 1–5 (1, normal/mild hypokinesia; 2, moderate hypokinesia; 3, severe hypokinesia; 4, akinesia; 5, dyskinesia). Wall motion score index was determined as the sum of segmental scores divided by the number of segments.[18] Follow-up variation (Δ) of LV-ESV was determined as the difference between LV-ESV at follow-up and LV-ESV at baseline divided LV-ESV at baseline and expressed as percentage [ΔLV-ESV(%)]. A ΔLV-ESV(%) ≥15% was considered as adverse LV remodelling.[19]

Statistical analysis

Continuous variables were expressed as mean ± SD or median (25th–75th percentiles). Categorical variables were expressed as frequency with percentage. Student's independent *t*- or the Mann–Whitney test was used as appropriate to compare continuous variable differences between patients with anterior and non-anterior MI.

Student's paired *t*- or Wilcoxon's test was used as appropriate to compare continuous variable differences between baseline and follow-up. A comparison between categorical variables was performed by χ^2 test or by Fisher's exact test if the expected cell count was <5. Pearson's correlation coefficient (*r*) was used to test correlation between continuous variables. On the basis of previous studies and expecting ΔLV-ESV(%)≥15% in 23 and 40% of non-anterior and non-anterior MI patients,[14] at least 167 patients had to be included to obtain a power of 90% and an α value of 0.05. Univariable logistic and linear analyses were utilized to determine the association of baseline variables with adverse LV remodelling and LV-EF at follow-up, respectively. Then, multivariable logistic and linear regression analyses were used to assess the influence of covariates on adverse LV remodelling and LV-EF at follow-up, respectively. For each dependent variable, three models were developed: *Model A*, solely MI location and MI size were entered in the model; *Model B*, tested the interaction between MI location and MI size; *Model C*, all covariates with $P < 0.10$ at univariable analysis were entered in the model. Stepwise selection was used for Model C. Given the strong correlation between MI size and AAR extent ($r = 0.778$, $P < 0.001$), between MI size and infarct transmurality ($r = 0.707$, $P < 0.001$), and between LV-ESV and LV-EF ($r = -0.730$, $P < 0.001$), only MI size and LV-EF were entered in Model C. Statistical analysis was performed by SPSS software for Windows (18.0 release; SPSS, Chicago, IL, USA), and all tests were two-tailed at 5% significance level.

Results

Study population

Thirty-seven (12%) patients were excluded from the study because of insufficient T2-weighted imaging quality, yielding a total of 260 patients (218 men, age 59 ± 11 years). Patients were dichotomized in anterior MI ($n = 127$, 49%) and non-anterior MI ($n = 133$, 51%)

Table 1 Baselines characteristics

Characteristics	Anterior MI ($n = 127$)	Non-anterior MI ($n = 133$)	*P*-value
Age (years)	58 ± 11	59 ± 10	0.31
Male, *n* (%)	102 (80)	116 (87)	0.13
Cardiovascular risk factors, *n* (%)			
Smoke	68 (53)	76 (57)	0.34
Familial history of CAD	56 (44)	50 (38)	0.22
Diabetes mellitus	18 (14)	15 (11)	0.51
Hypertension	49 (38)	58 (44)	0.50
Hyperlipidaemia	70 (55)	64 (48)	0.21
Systolic BP (mmHg)	134 ± 25	134 ± 22	0.94
Diastolic BP (mmHg)	81 ± 14	79 ± 14	0.26
Heart rate (b.p.m.)	75 ± 19	65 ± 17	<0.001
Time to reperfusion (min)	268 ± 150	250 ± 145	0.35
Maximum serum troponin I (μg/L)	71 (25–136)	60 (25–99)	0.21
Glycoprotein inhibitor IIb/IIIa, *n* (%)	97 (79)	91 (76)	0.93
Infarct-related artery, *n* (%)[a]			
LAD (prox/mid/dist)	127 (67/54/6)		<0.001
RCA (prox/mid/dist)		109 (53/37/19)	
LCx (prox/dist)		24 (16/8)	
TIMI flow-grade pre-PCI, *n* (%)			
0/1	86 (68)	102 (77)	0.11
2/3	41 (32)	31 (23)	
TIMI flow-grade post-PCI, *n* (%)			
0/1	5 (4)	2 (1)	0.23
2/3	122 (96)	131 (99)	
Medication at discharge, *n* (%)			
ACE/angiotensin-2 inhibitors	114 (90)	111 (83)	0.22
β-Blocker	106 (83)	101 (76)	0.26
Statin	118 (93)	119 (89)	0.54
Diuretics	21 (16)	12 (9)	0.21

ACE, angiotensin-converting enzyme; BP, blood pressure; CAD, coronary artery disease; LAD, left anterior descending coronary artery; LCx, left circumflex coronary artery; PCI, percutaneous coronary intervention; RCA, right coronary artery; TIMI, thrombolysis in myocardial infarction.
[a]Based on the American Heart Association classification.[23]

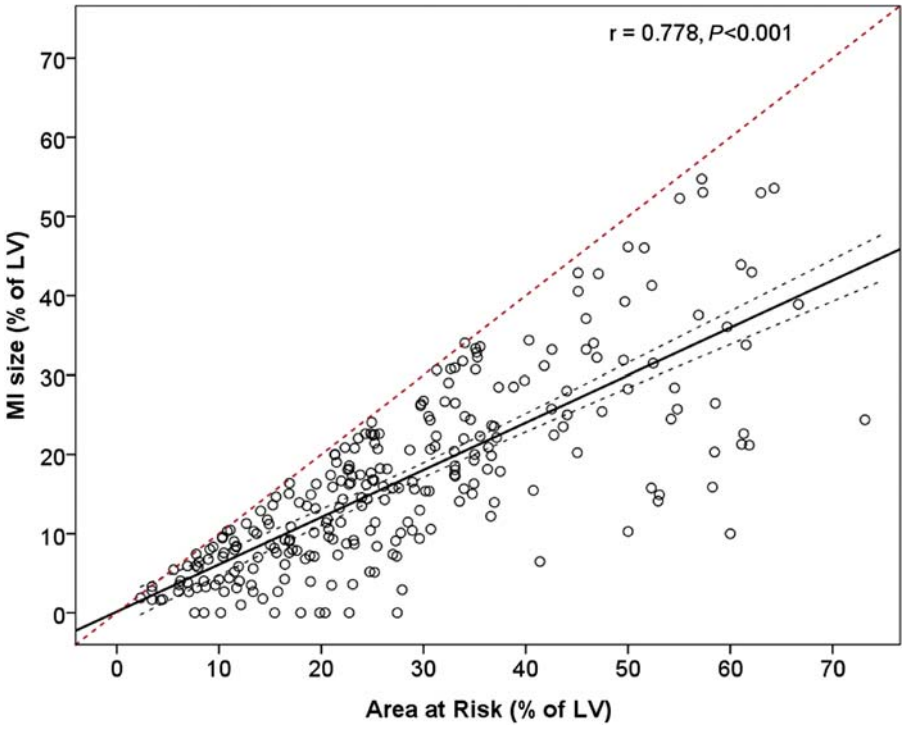

Figure 1 Scatterplot of myocardial infarction size and area at risk. The size of myocardial infarction is linearly and strongly related to the extent of area at risk. The extent of area at risk is consistently greater than myocardial infarction size. Red dotted line represents the identity line. Black straight and dotted lines represent the correlation and mean confidence intervals lines, respectively.

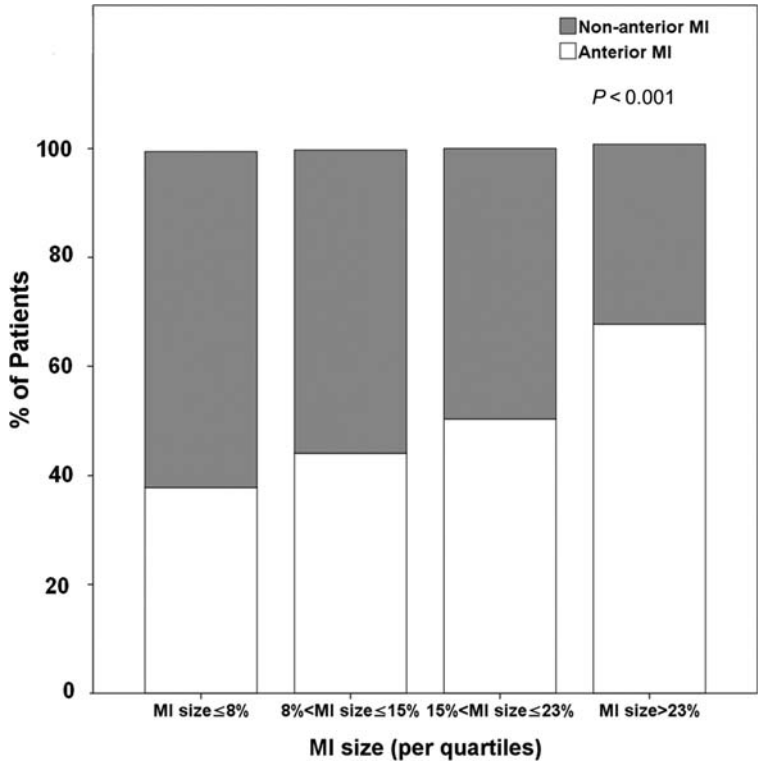

Figure 2 Patients distribution according to infarct location and myocardial infarction size. Patients with non-anterior and anterior myocardial infarction are more frequently distributed in low and high quartiles of myocardial infarction size, respectively.

Table 2 Left ventricular volumes and function in patients with anterior and non-anterior myocardial infarction

Measurements	Anterior MI (n = 127)	Non-anterior MI (n = 133)	P-value
Baseline			
MSI	0.40 ± 0.25	0.41 ± 0.25	0.74
AAR (% of LV)	32 ± 16	24 ± 13	<0.001
MI size (% of LV)	19 ± 12	14 ± 10	0.001
MI transmurality (%)	78 ± 25	72 ± 28	0.20
MO, n (%)	62 (47)	60 (45)	0.71
MO size (% of LV)	4 ± 3	3 ± 4	0.81
LV-EDV (mL)	151 ± 39	152 ± 34	0.97
LV-ESV (mL)	79 ± 29	76 ± 24	0.31
LV-mass (g)	124 ± 30	122 ± 28	0.56
LV-WSMI	1.72 ± 0.42	1.55 ± 0.40	0.005
LV-EF (%)	48 ± 9	51 ± 9	0.030
Follow-up			
MI size (% of LV)	14 ± 9	9 ± 7	<0.001
MI transmurality (%)	67 ± 27	63 ± 29	0.42
LV-EDV (mL)	161 ± 46	156 ± 38	0.42
LV-ESV (mL)	83 ± 36	74 ± 27	0.024
LV-mass (g)	110 ± 24	110 ± 25	0.89
LV-WMSI	1.55 ± 0.44	1.43 ± 0.40	0.050
LV-EF (%)	50 ± 11	54 ± 9	0.001

AAR, area at risk; EDV, end-diastolic volume; EF, ejection fraction; ESV, end-systolic volume; LV, left ventricular; MI, myocardial infarction; MO, microvascular obstruction; MSI, myocardial salvage index; WMSI, wall motion score index.

based on the location of LGE on post-contrast imaging. In nine patients (3.5%) without evidence of baseline LGE (aborted MI), the location of MI was attributed according to the myocardial oedema location on T2-weighted imaging. Baseline characteristics are summarized in *Table 1*. Heart rate was lower in non-anterior than anterior MI patients. All infarct-related arteries were successfully stented with bare-metal or drug-eluting stents. During follow-up, six patients were hospitalized because of heart failure, five underwent PCI for recurrent angina, whereas no cardiac deaths or re-infarction occurred.

Infarct characteristics, left ventricular volumes, and function in anterior and non-anterior MI

In the whole study population, AAR was 28 ± 15% (2–73%) and baseline MI size was 17 ± 12% (0–55%) yielding a MSI of 0.40 ± 0.25 (0.00–1.00). The extent of baseline MI was linearly and strongly related to the magnitude of AAR (*Figure 1*). By stratifying patients with anterior and non-anterior MI into subgroups based on baseline MI size, there were more patients with anterior MI in the high quartiles of MI size, whereas non-anterior MI patients were mainly distributed in the low quartiles of MI size (*Figure 2*). Cardiovascular magnetic resonance findings in anterior and non-anterior MI patients are summarized in *Table 2*.

At baseline, although MSI was closely similar between the two groups, AAR extent and MI size were greater in patients with anterior MI than in those with non-anterior MI (*Figure 3*).

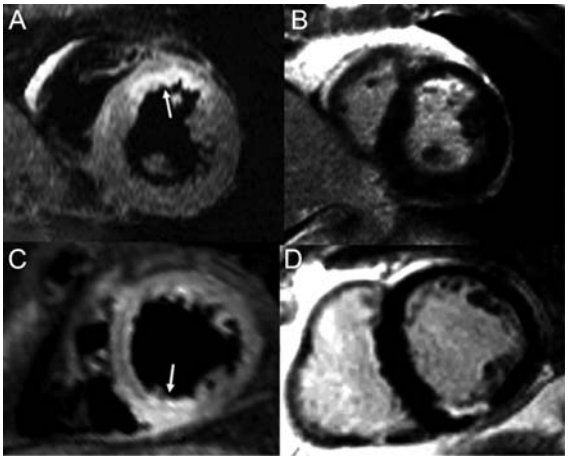

Figure 3 Relationship between infarct location and size. T2-weighted (*A* and *C*) and late post-contrast (*B* and *D*) images depicting, respectively, infarct-related myocardial oedema (arrows) and late-gadolinium enhancement in a patient with acute anterior (*A* and *B*) myocardial infarction and in one with acute inferior myocardial infarction (*C* and *D*). Although the myocardial salvage index is closely similar in the two patients (0.61 vs. 0.62), the extent of area at risk and myocardial infarction size are larger in the patient with anterior myocardial infarction (23 vs. 13% of left ventricle for area at risk; 9 vs. 5% of left ventricle for myocardial infarction size).

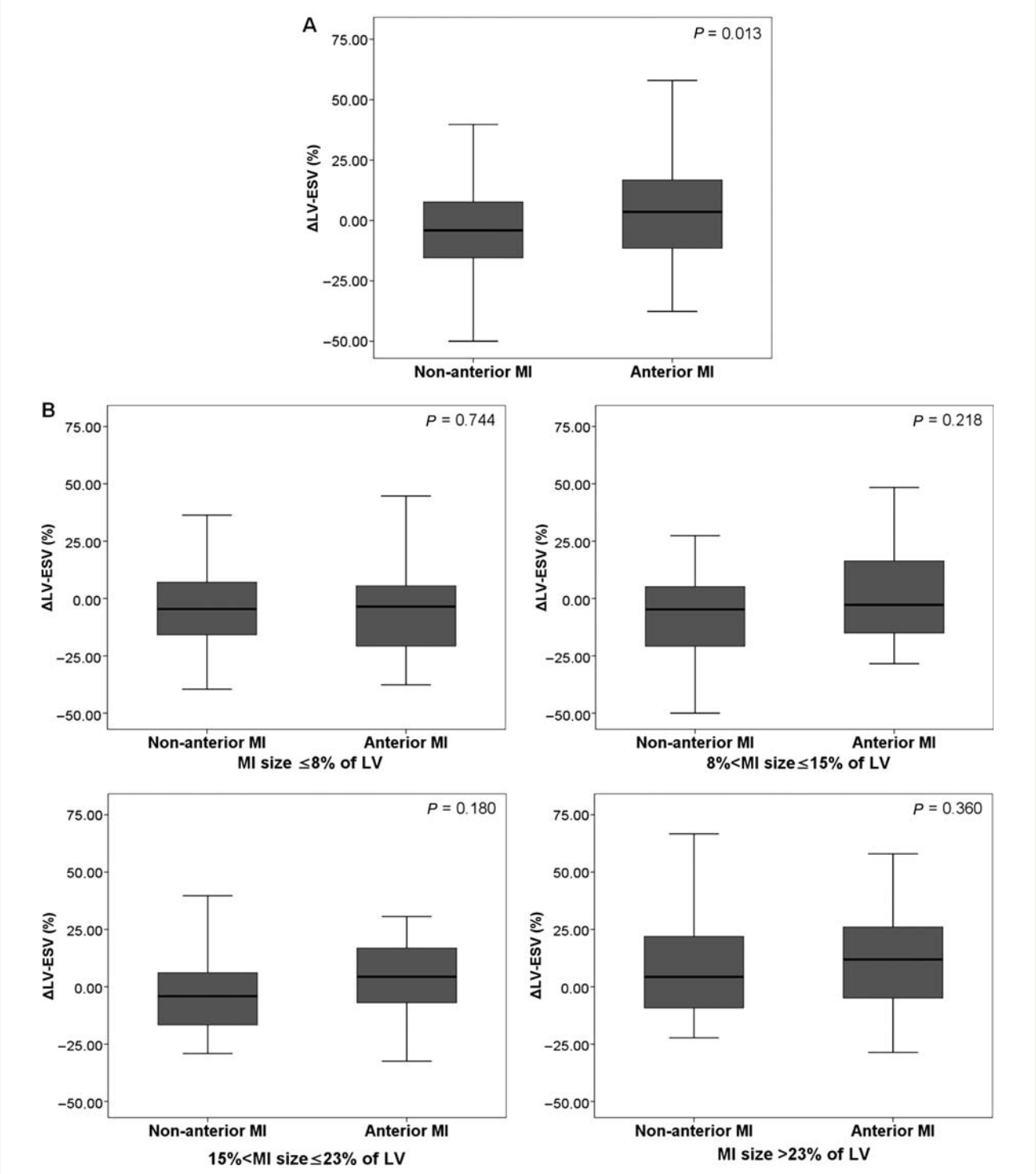

Figure 4 Post-infarction LV remodelling according to infarct location and myocardial infarction size. In contrast to non-anterior myocardial infarction patients those with anterior myocardial infarction increased left ventricular end-systolic volume [ΔLV-ESV(%)] during follow-up (*A*), indicating adverse LV remodelling. This result was not maintained when patients were stratified based on quartiles of myocardial infarction size (*B*).

Patients with anterior MI showed worse regional and global LV systolic function than non-anterior MI patients. Infarct size was positively related to LV-EDV ($r = 0.230$, $P < 0.001$) and LV-ESV ($r = 0.385$, $P < 0.001$) and inversely related to LV-EF ($r = -0.457$, $P < 0.001$).

At follow-up, MI size remained greater in anterior than in non-anterior MI patients yielding larger LV-ESV and lower LV-EF. Infarct size was positively related to LV-EDV ($r = 0.382$, $P < 0.001$) and LV-ESV ($r = 0.570$, $P < 0.001$) and inversely related to LV-EF ($r = -0.602$, $P < 0.001$). In both groups, LV mass and infarct

Table 3 Univariable analysis for the prediction of adverse left ventricular remodelling

Baseline characteristics	Odds ratio (95% CI)	*P*-value
Age (years)	1.006 (0.979–1.033)	0.682
Gender (female)	1.192 (0.559–2.541)	0.649
Diabetes	1.750 (0.795–3.852)	0.165
Hypertension	1.322 (0.741–2.360)	0.344
Time to reperfusion (min)	1.001 (0.999–1.003)	0.269
TIMI flow pre-PCI (0,1 vs. 2,3)	0.567 (0.282–1.143)	0.113
TIMI flow post-PCI (0,1 vs. 2,3)	0.397 (0.086–1.823)	0.235
AAR (% of LV)	1.027 (1.009–1.046)	0.004
MSI	0.108 (0.029–0.398)	0.001
MI size (% of LV)	1.061 (1.035–1.088)	<0.001
MI transmurality (%)	1.028 (1.007–1.050)	0.009
MO extent (% of LV)	1.236 (1.103–1.386)	<0.001
MI location (anterior vs. non-anterior MI)	2.042 (1.134–3.678)	0.017
LV-EDV (mL)	0.995 (0.987–1.003)	0.192
LV-ESV (mL)	0.997 (0.987–1.008)	0.643
LV-EF (%)	0.981 (0.950–1.012)	0.232

Abbreviations as reported in previous tables.

Table 4 Multivariable logistic regression analysis for the prediction of adverse left ventricular remodelling at follow-up

Baseline variables	Odds ratio (95% CI)	*P*-value
Model A		
MI location (anterior vs. non-anterior MI)	1.591 (0.859–2.973)	0.139
MI size (% of LV)	1.057 (1.031–1.085)	<0.001
Model B		
MI location (anterior vs. non-anterior MI)	0.772 (0.232–2.571)	0.674
MI size (% of LV)	1.035 (0.995–1.077)	0.090
MI location by MI size	1.038 (0.984–1.095)	0.168
Model C		
MSI	—	—
MI size (% of LV)	1.061 (1.035–1.088)	<0.001
MO extent (% of LV)	—	—
MI location (anterior vs. non-anterior MI)	—	—

Abbreviations as reported in previous tables.

transmurality decreased significantly between baseline and follow-up (all $P < 0.001$). In contrast to non-anterior MI patients, those with anterior MI increased ΔLV-ESV(%) during follow-up [−4% (−15 to 8%) vs. 3% (−12 to 17%), $P = 0.013$; *Figure 4A*]. Accordingly, adverse LV remodelling occurred in 38 (30%) patients with anterior MI and 23 (17%) patients with non-anterior MI ($P = 0.016$).

Table 5 Univariate analysis for the prediction of left ventricular ejection fraction at follow-up

Baseline characteristics	β-Coefficient	*P*-value
Age (years)	−0.076	0.221
Gender (female)	0.184	0.003
Diabetes	−0.091	0.147
Hypertension	0.045	0.472
Time to reperfusion (min)	−0.224	<0.001
TIMI flow pre-PCI (0,1 vs. 2,3)	0.082	0.082
TIMI flow post-PCI (0,1 vs. 2,3)	0.048	0.441
AAR (% of LV)	−0.360	<0.001
MSI	0.423	0.001
MI size (% of LV)	−0.545	<0.001
MI transmurality (%)	−0.481	<0.001
MO extent (% of LV)	−0.328	<0.001
MI location (anterior vs. non-anterior MI)	−0.200	0.001
LV-EDV (mL)	−0.301	<0.001
LV-ESV (mL)	−0.583	<0.001
LV-EF (%)	0.728	<0.001

Abbreviations as reported in previous tables.

Determinants of post-infarction left ventricular remodelling: contribution of infarct location and myocardial infarction size

At univariable logistic regression analysis, anterior MI, lower MSI, larger AAR, greater infarct transmurality, larger extent of MI, and MO were associated with adverse LV remodelling (*Table 3*). The risk of developing adverse LV remodelling was two-fold higher in anterior than in non-anterior MI patients. However, when the MI site was corrected for baseline MI size, the anterior location of infarction was not any longer associated with adverse LV remodelling (*Table 4*, Model A). No significant interaction was observed between the location and size of MI (*Table 4*, Model B). At multivariable logistic regression analysis, baseline MI size remained the only independent predictor of adverse LV remodelling after correction for other baseline determinants (*Table 4*, Model C). This result was also confirmed by considering adverse LV remodelling as a continuous [i.e. ΔLV-ESV(%)]. In contrast to non-anterior MI patients, those with anterior MI increased LV-ESV during follow-up, but this difference was not maintained when patients were stratified according to the quartiles of MI size (*Figure 4B*).

We also evaluated the influence of baseline variables on LV-EF at follow-up (*Table 5*). Anterior MI location was associated with reduced LV-EF at follow-up, but this result was not maintained by accounting for baseline MI size (*Table 6*, Model A). No

Table 6 Multivariable analysis for prediction of left ventricular ejection fraction at follow-up

Baseline variables	β-Coefficient	P-value
Model A		
MI location (anterior vs. non-anterior MI)	−0.090	0.091
MI size (% of LV)	−0.527	<0.001
Model B		
MI location (anterior vs. non-anterior MI)	−0.005	0.954
MI size (% of LV)	−0.455	<0.001
MI location by MI size	−0.136	0.245
Model C		
Gender (female)	—	—
Time to reperfusion (min)	−0.096	0.022
TIMI flow pre-PCI (0,1 vs. 2,3)	—	—
MSI	—	—
MI size (% of LV)	−0.255	<0.001
MO extent (% of LV)	—	—
MI location (anterior vs. non-anterior MI)	—	—
LV-EDV (mL)	—	—
LV-EF (%)	0.596	<0.001

Abbreviations as reported in the previous tables.

significant interaction was observed between MI location and its size (*Table 6*, Model B). At multivariable linear regression analysis, larger baseline MI size, longer time to reperfusion, and reduced baseline LV-EF were associated with lower LV-EF at follow-up (*Table 6*, Model C).

Discussion

This study demonstrated that although the degree of salvaged myocardium was closely similar between patients with anterior and non-anterior MI, those with anterior MI had larger MI size due to greater amount of myocardium at risk. As a result, patients with anterior MI experienced more extensive post-infarction remodelling and dysfunction without any independent contribution of infarct location. Accordingly, baseline MI size measured by post-contrast CMR but not its location was an independent predictor of adverse LV remodelling and dysfunction at 4-month follow-up.

Several studies, mainly conducted in the pre-reperfusion era, indicated that patients with anterior MI had worse post-infarction LV remodelling and prognosis than those with non-anterior MI independently of initial extent of myocardial damage.[1–3] Conversely, other studies[8,9] showed larger myocardial necrosis in anterior than in non-anterior MI patients, suggesting that MI size but not its location was an independent predictor of post-infarction prognosis.[9] This discordance can be primarily ascribed to the lack of a means enabling an accurate quantification of ischaemic LV damage. Using a comprehensive CMR approach, we demonstrated that anterior MI patients experienced larger irreversible ischaemic LV damage than patients with non-anterior MI. This difference was mainly due to a greater magnitude of myocardium at risk intrinsic to anterior infarcts since the reperfusion treatment was equally effective in patients with anterior and non-anterior MI, as denoted by a similar degree of salvaged myocardium in the two groups. Indeed, patients with anterior MI had greater myocardium at risk than non-anterior MI, and baseline MI size was linearly and strongly related to AAR extent. These findings are nicely concordant with those of previous ^{99m}Tc-sestamibi myocardial scintigraphy studies.[10] In patients with acutely reperfused MI, Christian *et al.* demonstrated that myocardium at risk accounted for the most of the variability of baseline MI size, thus patients with anterior MI had larger infarct size than those with non-anterior MI, although the amount of salvaged myocardium was similar in the two groups. Our study confirmed and expanded these results by showing that the increased likelihood of post-infarction LV remodelling and dysfunction associated with anterior MI was the consequence of greater LV damage without any independent contribution of MI location. This was demonstrated by two different approaches. First, although univariable analysis showed that anterior MI location was associated with two-fold increased risk of adverse LV remodelling and dysfunction at follow-up, this result was not confirmed when infarct location was accounted for MI size. Secondly, in contrast to patients with non-anterior MI, those with anterior MI significantly increased LV-ESV during follow-up. However, this difference was not maintained when patients were stratified in subgroups of similar baseline MI size. Although earlier studies[6,7] suggested that in patients with anterior MI the disproportionate stretching and thinning of infarcted LV apex (i.e. infarct expansion) yielded progressive LV enlargement and dysfunction, our findings did not support an independent contribution of MI location on post-infarction remodelling. This discrepancy can be explained by the difference in study populations. In fact, infarct expansion was observed in patients with non-reperfused transmural anterior MI, whereas our study cohort comprised patients with acutely reperfused MI with a mean salvaged myocardium of 40%. Previously, we demonstrated that in patients with reperfused anterior MI, the salvaged epicardium opposes to the adverse remodelling of the infarcted region.[20]

Overall, our findings support the concept that reperfused infarcts of equal size located either in anterior or non-anterior LV walls had a similar likelihood of adverse LV remodelling and dysfunction. This finding is in line with that of Orn *et al.*[21] who demonstrated that infarct size estimated by post-contrast CMR but not its location was an independent determinant of adverse LV remodelling and dysfunction in 57 patients with chronic MI. On the other hand, studies[4,5] conducted in large cohorts of reperfused ST-segment elevation MI patients indicated that the anterior location of MI was a strong and independent prognostic predictor, and accordingly, MI location was included in risk stratification models. However, in these studies, MI location was not accounted for MI size and thus the independent contribution made by MI location likely reflected the larger amount of myocardial necrosis intrinsic to anterior infarcts. Interestingly, a detailed analysis from GISSI trial[22] showed that infarct extent, estimated by the number of leads with ST-segment elevation, was more important than infarction location in predicting in-hospital outcome.

Study limitation

Although this was a three-centre study using different vendor CMR units, a similar study protocol was used with centralized data analysis. T2-weighted imaging has an inherently low signal-to-noise ratio and it is susceptible to signal loss in cardiac structures distant from the surface coil. However, all CMR units used an SI correction algorithm to homogenize signal throughout the field-of-view. Our findings should be interpreted with caution in patients with non-reperfused or non-ST-segment elevation MI. Given the short follow-up period, the influence of the location and size of MI on clinical outcome was not evaluated.

Conclusions

Patients with anterior MI experienced more extensive post-infarction LV remodelling and dysfunction than those with non-anterior MI due to larger amount of irreversible ischaemic LV damage intrinsic to anterior infarcts without any independent contribution of MI location. Accordingly, the size of baseline MI estimated by LGE imaging but not its location is an independent predictor of post-infarction LV remodelling and dysfunction at 4-month follow-up.

Supplementary material

Supplementary material is available at *European Heart Journal* online.

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