CLINICAL RESEARCH

Comparison of bleeding complications and 3-year survival with low-molecular-weight heparin versus unfractionated heparin for acute myocardial infarction: The FAST-MI registry

Comparaison des complications hémorragiques et de la survie à trois ans entre l’utilisation des héparines de bas poids moléculaire et l’héparine non fractionnée pour la prise en charge des infarctus du myocarde : registre FAST-MI

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Abbreviations: ACS, Acute Coronary Syndrome; AMI, Acute Myocardial Infarction; ATOLL, Acute ST-elevation myocardial infarction Treated with primary angioplasty and intravenous enoxaparin or unfractionated heparin to Lower Ischaemic and bleeding events at short- and Long-term follow-up; FAST-MI, French registry of Acute ST-elevation or non-ST-elevation Myocardial Infarction; ICU, Intensive Care Unit; LMWH, Low-Molecular-Weight Heparin; NSTEMI, Non-ST-segment Elevation Myocardial Infarction; PCI, Percutaneous Coronary Intervention; STEMI, ST-segment Elevation Myocardial Infarction; TIMI, Thrombolysis in Myocardial Infarction; UFH, Unfractionated Heparin.

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Summary

Background. — Recent clinical studies suggest that low-molecular-weight heparin (LMWH) could be an effective and safe alternative to unfractionated heparin (UFH) for patients with acute myocardial infarction (AMI).

Aims. — To assess the impact of anticoagulant choice (LMWH vs UFH) on bleeding, the need for blood transfusion and 3-year clinical outcomes in AMI patients from the FAST-MI registry.

Methods. — FAST-MI was a nationwide registry compiled in France over 1 month in 2005, which included consecutive AMI patients admitted to an intensive care unit less than 48 hours from symptom onset in 223 participating centres.

Results. — A total of 2854 patients treated with heparins were included. The risks of major bleeding or transfusion (3.0% vs 7.0%) and in-hospital death (3.2% vs 9.2%) were lower with LMWH compared with UFH, a difference that persisted after multivariable adjustment (odds ratio [OR] 0.51, 95% confidence interval [CI] 0.34–0.76 and OR 0.53, 95% CI 0.37–0.76, respectively). Three-year survival, and stroke and reinfarction-free survival risks were also higher with LMWH compared with UFH (adjusted hazard ratio [HR] 0.73, 95% CI 0.61–0.87 and HR 0.73, 95% CI 0.62–0.85, respectively). In two cohorts of patients matched on propensity score for receiving LMWH and with similar baseline characteristics (834 patients per group), major bleeding and transfusion rates were lower while the 3-year survival rate was significantly higher in patients receiving LMWH.

Conclusion. — Our data suggest that the use of LMWH in AMI patients may have a better benefit/risk profile than UFH, in terms of bleeding, need for transfusion and long-term survival.

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KEYWORDS
Acute myocardial infarction;
Bleeding;
Low-molecular-weight heparin;
Unfractionated heparin

Background

Several clinical studies have demonstrated that LMWHs (mainly enoxaparin) are an effective and safe alternative to UFH for the management of patients with ACS, with clinical benefit maintained long-term [1—8]. A recent meta-analysis including more than 30,000 patients undergoing PCI showed that enoxaparin is superior to UFH in reducing mortality and bleeding outcomes, especially in patients undergoing PCI for STEMI [9]. This meta-analysis confirms the results recently reported in the ATOLL randomized trial, in which the use of intravenous enoxaparin compared with UFH reduced clinical ischaemic outcomes without differences in bleeding and procedural success [10].

We aimed to determine, in a "real-world" setting, the impact of LMWH compared with UFH, in terms of bleeding events and long-term clinical outcomes in patients with AMI from the FAST-MI.

MOTS CLÉS
Infarctus du myocarde ;
Saignement ;
Héparines de bas poids moléculaire ;
Héparine non fractionnée

Résumé

Contexte. — Les dernières études cliniques suggèrent que les héparines de bas poids moléculaires (HBPM) représentent une alternative sûre et efficace à l’héparine non fractionnée (HNF) pour la prise en charge des patients avec un infarctus du myocarde (IDM).

Objectifs. — Évaluer l’impact des HBPM par rapport à l’HNF sur les saignements et le devenir des patients présentant un IDM à partir du registre FAST-MI.

Méthodes. — FAST-MI est un registre national ayant inclus au cours d’un mois fin 2005 les patients ayant présenté un IDM au sein de 223 centres participants. Nous avons évalué l’impact des HBPM sur les saignements, les transfusions et la survie à trois ans.

Résultats. — Au total, 2854 patients traités par héparine ont été inclus. Le risque de saignement majeur ou de transfusion (3.0% vs 7.0%, p < 0.001) et de décès intra-hospitalier (3.2% vs 9.2%, p < 0.001) étaient significativement moins élevés avec les HBPM que avec l’HNF ; résultats confirmés sur les analyses multivariées (OR 0.51, IC 95% 0.34–0.76 et OR 0.53, IC 95% 0.37–0.76, respectivement). L’utilisation des HBPM était associée de façon significative à une meilleure survie à trois ans et à la survenue de moins d’événements cardiovasculaires majeurs (décès, infarctus, accident vasculaire cérébral) comparée à l’HNF (HR 0.73, IC 95% 0.61–0.87 et HR 0.73, IC 95% 0.62–0.85, respectivement). Sur deux cohortes de patients traités par HBPM contre HNF, les patients traités par HBPM avaient significativement une meilleure survie à trois ans et moins de saignements majeurs et de transfusions.

Conclusion. — Cette étude démontre que l’utilisation des HBPM chez les patients présentant un IDM est associée à une diminution des saignements, des transfusions et à une meilleure survie comparée à ceux traités par HNF.

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Methods

Patient population

The methods of the FAST-MI registry have been described in detail elsewhere [11,12]. Briefly, the primary objective was to evaluate "real-life" MI management practices and to measure their impact on medium- and long-term prognosis in patients admitted to ICUs with AMI (within 48 hours). This registry resulted from a prospective multicentre (223 centres) study that included 3059 patients. Patients were recruited consecutively from ICUs over a period of 1 month (October 2005). Participation in the study was offered to all French institutions, university teaching hospitals, general and regional hospitals and private clinics with ICUs capable of receiving ACS emergencies.

Men and women aged over 18 years were included if they agreed to take part in the study and were admitted within 48 hours after symptom onset for an AMI characterized by the elevation of troponin or creatine phosphokinase-MB associated with at least one of the following elements: symptoms compatible with myocardial ischaemia; new pathological Q waves; and ST-T changes compatible with myocardial ischaemia.

Main exclusion criteria were: iatrogenic MI (defined as an MI occurring within 48 hours of a therapeutic procedure [bypass surgery, coronary angioplasty or any other medical or surgical intervention]); ACS diagnosis invalidated in favour of another diagnosis; unstable angina; and no increase in cardiac biomarkers.

Participation in the registry did not change the therapeutic approach of the cardiologist in any way. The registry was conducted in compliance with Good Clinical Practice, French Law and the French Data Protection Law. The protocol was reviewed by the Committee for the Protection of Human Subjects in Biomedical Research of Saint-Antoine Hospital and the FAST-MI registry data file was declared to the Commission Nationale Informatique et Liberté. Clinicaltrials.gov identifier: NCT00673036.

Definition of the heparin groups

Two groups were formed according to the anticoagulant used during the first 48 hours: the LMWH group and the UFH group. Patients who received both anticoagulants were included in the LMWH group.

Definition of myocardial infarction and strategy

Although the diagnosis of AMI was independently made at each participating centre, to avoid heterogeneous criteria it was suggested that STEMI be defined as ST-segment elevation more than or equal to 1 mm or new bundle branch block seen in at least two contiguous leads at any location in the index or qualifying electrocardiogram, and that NSTEMI (non-Q wave MI) be defined as no ST-segment elevation seen in the index or qualifying electrocardiogram. Patients who died very early after admission and in whom cardiac markers were not measured were included if they had compatible signs or symptoms associated with typical ST changes.

Data collection and follow-up

Data on baseline characteristics (demographics, risk factors and medical history) were collected prospectively. All data were recorded on computerized case record forms by dedicated research technicians sent to each of the centres at least once a week. Follow-up data were collected through contact with the attending physicians, the patients or their families. If missing, vital status was assessed from the registry of the patient’s birthplace. Three-year follow-up was 97% complete. Bleeding was classified as major or minor according to the TIMI criteria [13]. Regarding bleeding complications, four endpoints of interest were used: in-hospital major bleeding (defined as a fall in haemoglobin more than or equal to 5 g, a fall in haematocrit more than or equal to 15%, intracranial haemorrhage, retroperitoneal bleeding); minor bleeding (defined as fall in haemoglobin of 3–5 g/dL, a fall in haematocrit of 10–15%); use of any transfusion during the hospital stay; and 3-year survival.

Statistical analysis

Statistical analysis was performed using SPSS 20.0 software (IBM, Armonk, NY, USA). For quantitative variables, means, standard deviations and minimum and maximum values were calculated. In addition, medians with interquartile ranges were calculated for some of the variables. Discrete variables are presented as percentages. Comparisons were made with the Chi² test or Fisher’s exact test for discrete variables and with unpaired t tests, Wilcoxon sign-rank tests or one-way analyses of variance for continuous variables. Survival curves according to management methods were estimated using the Kaplan–Meier estimation and compared using a log-rank test. Multivariable analyses of predictors of in-hospital endpoints were made by using a backward stepwise multiple logistic regression method. Correlates of survival were determined using a multivariable backward stepwise Cox analysis. Variables listed in Table 1 were included in the models. In addition, a propensity score for receiving LMWH was calculated using multiple logistic regression and was used to build two cohorts of patients matched on the propensity score. Comparisons of events between the two propensity score-matched cohorts were made using similar methodology. For all analyses, P<0.05 was considered significant.

Results

Of the 3059 patients included in the registry, 2854 received heparin (either UFH or LMWH) during the first 48 hours; 6.7% of patients did not receive any heparin for various reasons and were excluded from the analysis.

Baseline characteristics

Baseline characteristics are described in Table 1; 1932 patients (67%) received LMWH and 922 patients received UFH during the first 48 hours. Patients who received UFH were older and had a higher cardiovascular risk (with a higher GRACE score) and a lower left ventricular ejection fraction than those who received LMWH.
In-hospital complications

In-hospital complications are described in Table 2. Major bleeding and blood transfusions occurred less frequently with LMWH compared with UFH. Specifically, however, intracranial haemorrhage (UFH 0.2% vs LMWH 0.1%), retroperitoneal bleeding (0.8% vs 0.3%) and minor bleeding (1.6% vs 0.8%) were not different. A significant interaction regarding the risk of major bleeding or transfusion was noted between type of heparin and use of fibrinolytic treatment, with a lower risk with LMWH in patients not receiving fibrinolytic agents (2.9% vs 8.4%) and a higher risk in those treated with fibrinolytics (3.0% vs 2.0%) \(P \) for interaction = 0.02. Rates of in-hospital reinfarction (UFH 1.3% vs LMWH 1.9%) and stroke (0.9% vs 1.0%) did not differ significantly. The in-hospital mortality rate was higher in patients receiving UFH (9.2% vs 3.2%). Among the 1932 LMWH-treated patients, 837 (43%) also received UFH at some time during the first 48 hours following admission or in the prehospital setting. The rates of major bleeding and blood transfusions were similar in those receiving LMWH compared with those receiving both types of heparins (1.8% vs 1.6%, \(P = 0.65 \) and 3.1% vs 2.4%, \(P = 0.34 \), respectively). Using multivariable logistic regression analysis, the use of LMWH was associated with a lower risk of major bleeding or blood transfusion and a lower risk of in-hospital death (odds ratio 0.53, 95% CI 0.37–0.76, \( P = 0.001 \)). Other independent predictors were chronic kidney failure for major bleeding and peripheral arterial disease, use of angiotensin receptor blockers before, and chronic renal failure for blood transfusions.

Long-term clinical outcomes

Long-term clinical outcomes are described in Table 2. The 3-year survival rate was higher in patients treated with LMWH compared with UFH (84.3% vs 72.5%, \( P < 0.001 \)) (Fig. 1). Similarly, the risk of major adverse cardiac events (3-year death, reinfarction and stroke) was also lower with LMWH (68.1% vs 80%, \( P < 0.001 \)) (Fig. 2). Subgroup analyses showed consistent results in STEMI or NSTEMI, men or women, low (less than
or equal to 23) or normal/high body mass index, use of PCI or not and increased creatinine concentration (more than or equal to 150 mg/dL) or not. Moreover, the 3-year survival rate was similar in patients who received only LMWH and in those who received both LMWH and UFH (LMWH only 84.6% vs combination 84.0%, \( P = 0.69 \)). Using Cox multivariable analysis, the use of LMWH was associated with a reduced risk of death at 3 years; other independent predictors were the GRACE score, the presence of an anterior MI, chronic renal failure and history of stroke. Likewise, the risk of death, re-MI or stroke at 3 years was significantly reduced with LMWH therapy (Table 2). In the subgroup of patients without major bleeding or transfusion, the use of LMWH remained associated with a reduced risk of 3-year death (15.1% vs 25.6%; hazard ratio 0.75, 95% CI 0.62–0.90, \( P = 0.002 \)) and of 3-year death, re-MI or stroke (19.6% vs 30.1%; hazard ratio 0.75, 95% CI 0.64–0.89, \( P = 0.001 \)).

### Propensity score-matched cohorts

The propensity score for receiving LMWH vs UFH was used to build two matched cohorts of 834 patients each, which had similar baseline characteristics (Table 3). As in the overall population, major bleeding and use of transfusions occurred less frequently in LMWH-treated patients. Three-year survival, and 3-year re-MI and stroke-free survival rates were significantly higher in the patients who received LMWH compared with those who did not (79% vs 75% and 75% vs 71%, respectively) (Figs. 3 and 4).

### Discussion

The present data, gathered from a nationwide registry of patients admitted for AMI, suggest a better benefit/risk in patients using LMWH compared with UFH at the acute stage of MI, with a reduced risk of bleeding and improved 3-year survival. This favourable profile was consistent across patient subgroups and persisted after multivariable adjustments and in propensity score-matched cohorts. The results extend our previous findings in elderly patients [14].

In this prospective registry, the use of LMWH was associated with a 27% relative risk reduction in mortality after

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**Table 2  In-hospital complications and 3-year clinical outcomes.**

<table>
<thead>
<tr>
<th></th>
<th>UFH (n = 922)</th>
<th>LMWH (n = 1932)</th>
<th>Adjusted OR or HR (95% CI)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major bleeding</td>
<td>32 (3.5)</td>
<td>33 (1.7)</td>
<td>0.66 (0.36–1.21)</td>
<td>0.17</td>
</tr>
<tr>
<td>Any blood transfusion</td>
<td>62 (6.7)</td>
<td>54 (2.8)</td>
<td>0.50 (0.33–0.75)</td>
<td>0.001</td>
</tr>
<tr>
<td>Major bleeding or transfusion</td>
<td>65 (7.0)</td>
<td>57 (3.0)</td>
<td>0.51 (0.34–0.76)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Three-year death</td>
<td>254 (27.5)</td>
<td>303 (15.7)</td>
<td>0.73 (0.61–0.86)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Three-year death, MI or stroke</td>
<td>294 (31.9)</td>
<td>387 (20.0)</td>
<td>0.73 (0.62–0.85)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Data are number (%). HR: hazard ratio; LMWH: low-molecular-weight heparin; MI: myocardial infarction; OR: odds ratio; UFH: unfractionated heparin.
Table 3  Baseline characteristics in cohorts matched on propensity score.

<table>
<thead>
<tr>
<th></th>
<th>UFH (n = 834)</th>
<th>LMWH (n = 834)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>68.5 ± 14.6</td>
<td>68.6 ± 14.0</td>
<td>0.88</td>
</tr>
<tr>
<td>Women</td>
<td>276 (33)</td>
<td>277 (33)</td>
<td>0.50</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>26.9 ± 5.1</td>
<td>26.7 ± 4.6</td>
<td>0.54</td>
</tr>
<tr>
<td>Hypertension</td>
<td>495 (59)</td>
<td>510 (61)</td>
<td>0.24</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>193 (23)</td>
<td>189 (23)</td>
<td>0.43</td>
</tr>
<tr>
<td>Current smoking</td>
<td>254 (31)</td>
<td>253 (30)</td>
<td>0.50</td>
</tr>
<tr>
<td>Hyperlipidaemia</td>
<td>371 (45)</td>
<td>362 (43)</td>
<td>0.35</td>
</tr>
<tr>
<td>Previous MI</td>
<td>138 (17)</td>
<td>144 (17)</td>
<td>0.37</td>
</tr>
<tr>
<td>Previous percutaneous intervention</td>
<td>102 (12)</td>
<td>104 (13)</td>
<td>0.47</td>
</tr>
<tr>
<td>Previous coronary artery bypass grafting</td>
<td>50 (6)</td>
<td>38 (5)</td>
<td>0.11</td>
</tr>
<tr>
<td>Previous heart failure</td>
<td>53 (6)</td>
<td>45 (5)</td>
<td>0.23</td>
</tr>
<tr>
<td>Previous stroke</td>
<td>45 (5)</td>
<td>47 (6)</td>
<td>0.46</td>
</tr>
<tr>
<td>Peripheral artery disease</td>
<td>87 (10)</td>
<td>83 (10)</td>
<td>0.40</td>
</tr>
<tr>
<td>Chronic renal insufficiency</td>
<td>42 (5)</td>
<td>44 (5)</td>
<td>0.46</td>
</tr>
<tr>
<td>STEMI</td>
<td>505 (61)</td>
<td>516 (62)</td>
<td>0.85</td>
</tr>
<tr>
<td>GRACE score</td>
<td>155 ± 37</td>
<td>155 ± 37</td>
<td>0.90</td>
</tr>
<tr>
<td>Fibrinolytic treatment</td>
<td>179 (21.5)</td>
<td>166 (20)</td>
<td>0.43</td>
</tr>
<tr>
<td>Left ventricular ejection fraction (%)</td>
<td>50 ± 14</td>
<td>52 ± 14</td>
<td>0.06</td>
</tr>
<tr>
<td>Atrial fibrillation on admission</td>
<td>78 (9)</td>
<td>74 (9)</td>
<td>0.40</td>
</tr>
<tr>
<td>Admission Killip class ≥ 2</td>
<td>211 (25)</td>
<td>211 (25)</td>
<td>0.52</td>
</tr>
<tr>
<td>Admission glycaemia (mg/dL)</td>
<td>157 ± 76</td>
<td>153 ± 66</td>
<td>0.23</td>
</tr>
<tr>
<td>Admission creatinine (mg/dL)</td>
<td>101 ± 41</td>
<td>101 ± 38</td>
<td>0.89</td>
</tr>
<tr>
<td>Left bundle branch block on admission</td>
<td>38 (5)</td>
<td>39 (5)</td>
<td>0.50</td>
</tr>
<tr>
<td>Anterior MI (% of STEMI)</td>
<td>216 (43)</td>
<td>217 (42)</td>
<td>0.43</td>
</tr>
<tr>
<td>Use of thrombolysis</td>
<td>196 (21)</td>
<td>265 (14)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antiplatelet agents before</td>
<td>197 (24)</td>
<td>214 (26)</td>
<td>0.18</td>
</tr>
<tr>
<td>Beta-blockers before</td>
<td>191 (23)</td>
<td>195 (22)</td>
<td>0.39</td>
</tr>
<tr>
<td>Statins before</td>
<td>208 (25)</td>
<td>201 (24)</td>
<td>0.37</td>
</tr>
<tr>
<td>Angiotensin-converting enzyme inhibitors before</td>
<td>271 (33)</td>
<td>302 (36)</td>
<td>0.06</td>
</tr>
<tr>
<td>Diuretics before</td>
<td>221 (26)</td>
<td>238 (29)</td>
<td>0.19</td>
</tr>
<tr>
<td>Calcium channel blockers before</td>
<td>163 (20)</td>
<td>158 (19)</td>
<td>0.40</td>
</tr>
<tr>
<td>Clopidogrel in first 48 hours</td>
<td>690 (83)</td>
<td>690 (83)</td>
<td>0.53</td>
</tr>
<tr>
<td>Use of GP IIb/IIIa inhibitors</td>
<td>288 (35)</td>
<td>303 (36)</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Data are mean ± standard deviation or number (%). GP: glycoprotein; GRACE: global registry of acute coronary events; LMWH: low-molecular-weight heparin; MI: myocardial infarction; NSTEMI: non-ST-segment elevation myocardial infarction; STEMI: ST-segment elevation myocardial infarction; UFH: unfractionated heparin.

* Included patients with previously documented diagnosis of hypercholesterolaemia treated with diet or medication, or new diagnosis made during this hospitalization with elevated total cholesterol more than 160 mg/dL; did not include elevated triglycerides.

3 years of follow-up, compared with UFH. This benefit was observed regardless of type of ACS (STEMI or NSTEMI), sex, body mass index, use of PCI and creatinine concentration. Our results are consistent with current published data and especially with the recent meta-analysis by Silvain et al., in which the use of enoxaparin was associated with a 34% relative risk reduction in mortality compared with UFH [1–9]. However, subgroup analyses suggested that the benefits on mortality and ischaemic complications were largely driven by the drug superiority in patients undergoing primary PCI for STEMI, whereas the better safety outcomes might be driven by the intravenous (vs subcutaneous) use of enoxaparin. These data confirm results recently reported in the ATOLL randomized trial [10]. Compared with UFH, intravenous enoxaparin at a dose of 0.5 mg/kg in patients undergoing primary PCI reduced death or resuscitated cardiac death in patients undergoing primary PCI by 42% and death or MI by 37%. Although the 40% relative risk reduction in all-cause mortality associated with enoxaparin in ATOLL was not significant (P = 0.08), it is consistent with the 38% reduction in mortality found in the group with STEMI in the current meta-analysis (P < 0.001).

This survival benefit is supported by concomitant reductions in both ischaemic and major bleeding complications, although in our study the survival benefit was driven by a reduction in bleeding outcomes only. Similar reductions in mortality were found in studies with only a reduction in bleeding outcomes, and support our findings [15]. Regarding bleedings, some studies have shown that the increased efficacy of LMWH may be accompanied by an increased risk of bleeding, especially in high-risk patients, such as the elderly or patients with renal failure who may receive an overdose of LMWH, which needs to be adapted in this fragile population [16–18]. However, this is disputed by most data from
the literature, which did not find a significantly increased risk associated with the use of LMWH, although an increase in minor bleeding has been reported [1,2,19–22]. In our study, the use of LMWH was associated with a significant reduction in major bleeding or transfusion compared with UFH, as in the meta-analysis of Silvain et al., in which a 20% relative risk reduction was observed [9]. No difference was observed in terms of bleeding complications according to the type of AMI in our study.

Current updated guidelines for anticoagulation in patients requiring PCI for STEMI or NSTEMI with a medium-to-high risk of ischaemia produced by the American College of Cardiology, American Heart Association and Society of Cardiac Angiography and Intervention, as well as guidelines from the Task Force on Myocardial Revascularization of the European Society of Cardiology, consider UFH as a class 1 recommendation for this indication, despite limited supporting evidence (level of evidence C) [14,23]. However, our study, as well as current available data and pharmacological properties, suggest that LMWH, especially enoxaparin, could be an attractive strategy in the management of patients with AMI.

Study limitations

Our study has the same limitation as all observational studies — namely, no causality can be asserted between variables that are correlated. Comparisons between patients receiving LMWH and those receiving UFH were not randomized and, despite careful adjustments for a large number of potentially confounding variables, the results can only be considered as indicative. The use of propensity score-adjusted cohorts, however, limits the biases inherent to observational data, by giving the opportunity to compare outcomes in cohorts of patients with similar baseline characteristics; this strengthens our findings considerably. One of the major limitations of this study is that the doses of LMWH and UFH used were not recorded in this registry. However, it is noteworthy that most centres used European Society of Cardiology guidelines (1 mg/kg subcutaneously twice daily) or dose-adjustment protocols that conform to the EXTRACT-TIMI 25 regimen for elderly patients (0.75 mg/kg subcutaneously twice daily) [3,24]. Finally, we did not distinguish between patients receiving enoxaparin or other LMWHs, as 96% of the patients on LMWH (1846/1932) received enoxaparin.

Conclusion

Our data show that the use of LMWH in real-world clinical practice is associated with less bleeding and a better 3-year survival rate in patients with AMI. These findings, which were confirmed in propensity score-matched populations with similar baseline characteristics, suggest that LMWH could replace UFH in these high-risk patients as the antithrombotic agent of choice in the management of ACS.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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