Postoperative myocardial damages after hip fracture repair are frequent and associated with a poor cardiac outcome: a three-hospital study

SIR—Long-term mortality after hip fracture repair (HFR) is high [1–3] and frequently caused by vascular death [4, 5–7]. Some data have pointed out that the onset of cardiac morbidity appears early in the course of hip fracture [8–10], but none have focused on the correlation between perioperative ischaemic complications and late cardiac outcome. In vascular surgery patients, studies have shown such a correlation especially by using Troponin measurement [11–16]. In a previous study, we have shown that this phenomenon exists also after hip surgery [17]. The incidence of a perioperative myocardial damage (PMD), as measured by troponin Ic (TnIc) release, was particularly high in the HFR population (22%) as were mortality (22%) and the incidence of major cardiac complications (MCC) (27%). To assess if this phenomenon was only due to the local recruitment of the institution in which the study was performed, the study was completed to include data from two other academic French institutions in which patients were also screened for a follow-up period of 6 months after surgery.

Methods

Following approval from each Local Research Ethics Committee, consecutive patients undergoing HFR were enrolled in three different institutions in this prospective, observational study after obtaining individual patient consent. Surgical procedures performed during off-duty hours were not included. All patients had a preoperative anaesthetic evaluation before surgery, and every effort was made to optimise any pathological process in <72h. The patients were screened according to predefined criteria that included components of the Revised Cardiac Risk Index (RCRI) [18]. All cardiac treatments remained unchanged until surgery, except for angiotensin-converting enzyme inhibitors which were stopped before surgery. All cardiac medications were started again on the ward after surgery. HFR was performed under general, spinal or combined anaesthesia. Serum TnIc was measured on the morning of each of the first three postoperative days and was analysed using electrochemiluminescence immunoassay on an Ortho Vitros EGi analyser (Ortho-Clinical Diagnostics, Raritan, NJ, USA) in two institutions and on a stratus II analyser (Dade-Behring, Paris La Défense, France) in the other one. Values greater than the upper reference limit specified by the manufacturer to be the 99th percentile concentration of a reference population [19] were considered positive. Namely, these values were respectively 0.08 ng/ml and 0.1 ng/ml.

The in-hospital follow-up was performed by the anaesthetist in charge of the orthopaedic ward, and data were collected prospectively. Patients were clinically assessed daily using a standardised form that included evaluation of chest pain and signs of cardiac failure.

The long-term follow-up was performed using semi-structured telephone interviews with the patient, his or her family or the physician in charge of the nursing home, 6 months after surgery to seek for MCC, determine mortality and its cause and record any further hospitalisation using a standardised form. Primary endpoint was the occurrence of MCC defined as cardiac death, myocardial infarction, unstable angina, need for coronary revascularisation and congestive heart failure. When such an event was suspected during the telephone interview, the diagnosis was confirmed by contacting the physician in charge of the patient and accessing medical records. As secondary endpoint, all-cause death was used.

Univariate statistical analysis was performed to compare patients according to the occurrence (or not) of MCC in the first six postoperative months, and according to the occurrence of death from any cause during the first six
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postoperative months. Continuous variables were compared using the unpaired $t$-test and dichotomous data with the $\chi^2$ test or Fisher’s exact test. Variables with a $P$-value $<0.2$ were included in a stepwise Cox regression analysis for MCC and death at 6 months. Statistical analysis were performed by using the Stata Statistical software release 8.0 for windows (Stata Corporation, College Station, TX, USA).

Results

From October 2003 to October 2004, 22 patients from our previous study had undergone HFR [17]. From May 2005 to April 2006, 53 patients were enrolled in the two other hospitals. All patients had at least two TnIc measurements during the postoperative course. Sixty-six patients (88%) had three measurements. Twenty patients (26.7%) showed elevated TnIc levels beyond normal threshold, 16 on the first postoperative day, 15 on day 2 and 10 on day 3. There was no statistical difference in baseline patients’ characteristics according to TnIc levels. Supplementary data concerning baseline patients’ characteristics are available at Age and Ageing online.

During the hospital stay, 10 cardiac events were clinically detected: seven being associated with a PMD and three without a PMD. Among the 20 patients with a PMD, symptomatic cardiac complications included intraoperative cardiovascular collapse ($n = 1$), postoperative cardiac arrest ($n = 2$), pulmonary oedema with electrical signs of ischaemia ($n = 2$) and typical chest pain without ECG modification ($n = 2$). One of the two cardiac arrests occurred in a patient who did not display any clinical or ECG sign of ischaemia. Two additional patients with a PMD showed ECG signs of ischaemia but had no cardiac symptom. Among patients without a PMD, there were one case of acute pulmonary oedema and two cases of typical chest pain.

During the out-of-hospital course, among the 20 patients who sustained a PMD, the incidence of cardiac events during the first 6 postoperative months was 30% versus 9% among those who remained free from a PMD ($P = 0.0313$), and the all-cause mortality was 40% versus 14.5% ($P = 0.0244$). Supplementary data concerning the postoperative outcome are available at Age and Ageing online.

A univariable relationship between demographic and clinical characteristics and major postoperative outcomes after HFR is shown in Table 1. In a Cox model including a PMD, age, ASA status and RCRI, the only independent factor associated with MCC was PMD (HR = 6.6, CI 95% 1.5–28.7). In a Cox model including PMD, age, ASA status and hospital, PMD was an independent correlate of all-cause mortality at 6 months (HR = 3.6, CI 95% 1.03–12.7). The only other independent correlate was age $>$90 (HR = 10.5, CI 95% 1.3–85). Kaplan–Meier survival curves of all-cause mortality and MCC at 6 months for patients with a PMD are shown in Figure 1.

Table 1. Univariable relation between demographic and clinical characteristics and major postoperative outcomes after hip fracture repair

<table>
<thead>
<tr>
<th></th>
<th>MCC</th>
<th>Death</th>
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<tr>
<td>Gender</td>
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<td>ns</td>
</tr>
<tr>
<td>Age</td>
<td>ns</td>
<td>0.0103</td>
</tr>
<tr>
<td>RCRI</td>
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<td>0.0244</td>
</tr>
<tr>
<td>Hospital</td>
<td>0.0463</td>
<td>0.0421</td>
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</tbody>
</table>

MCC = major cardiac complications, RCRI = revised cardiac risk index [14], ASA = American Society of Anaesthesiology.

Discussion

In this study of HFR patients, 20/75 (27%) sustained a PMD as evidenced by elevated troponin I, and this was strongly associated with MCC and death during the first 6 postoperative months. These findings are consistent with the clinical impact of myocardial injury with TnIc release on cardiac outcome suggested by previous studies [11, 12, 20–23].

At first glance, the 27% incidence of a PMD retrieved in this study could seem high since previous studies [18, 24–26] evaluating perioperative cardiac morbidity in patients undergoing orthopaedic surgery have focused on elective surgery,
but studies that have specifically investigated the incidence of cardiac morbidity in patients with hip fractures have retrieved an incidence of perioperative cardiac events comparable with our data [10, 27]. The rate of PMD we observed was also consistent with those of Fisher et al. and Dawson-Bowling who founded respectively 29% and 39% of Troponin elevation in hip fracture patients [8, 9]. Nevertheless, none of these studies have focused on the relationship between PMD and late cardiac outcome. For our part, we found a 21% mortality rate and a 14.7% incidence of MCC 6 months after surgery both associated with the occurrence of a PMD. These data are consistent with earlier studies showing high long-term mortality rates after HFR [2, 4] and recent studies reporting cardiac events as the principal cause of death (27–63%) after HFR [4, 5–7].

In our study, a limited number of the cardiovascular complications were detected clinically during the hospital stay (13%), but most of them (7/10) were associated with a PMD. Furthermore, ECG evidence of ischaemia was disclosed in only five patients. These data agree with previous studies comparing the clinical follow-up and biomarkers or continuous ECG monitoring [16, 20, 28, 29] and suggest that TnIc measurement is a very useful tool to detect patients at high risk for both in-hospital and late cardiac complications including death.

There are several limitations to this study. The number of patients studied was relatively small. A larger study is still necessary to verify the high incidence of increased postoperative TnIc found here and to identify other preoperative clinical predictors. Nevertheless, our sample size was large enough to address the main question we addressed, i.e. the correlation between TnIc elevation and cardiac outcome. Outcome after HFR is correlated with quality of care [30], and we did not perform in-depth evaluation of our practice patterns to verify that care was adequate. However, institutions in which the study was performed are academic hospitals, and physicians overall comply with recommended guidelines suggesting that results that were obtained can be generalised. Preoperative TnIc was not measured in our population, and we cannot exclude that some patients, especially those operated for HFR, did not present with preoperative cardiac complications and/or abnormal TnIc levels. Nevertheless, we did not choose to address the question of the onset time of myocardial injury but to assess the incidence of myocardial injury and its association with late cardiovascular outcome.

In conclusion, PMD with TnIc release is a common phenomenon after HFR. This phenomenon is associated with a 6.6-fold increase in MCC during a 6-month follow-up and a 3.6 increased mortality as compared to patients free of a PMD. Our study suggests that these elderly patients may be at high risk of cardiac events. This can be of great interest since half of postoperative deaths after HFR could be avoidable [31], and knowing causes of poor postoperative outcome offers the opportunity to focus on specific interventions [10]. Further studies are needed to explore which perioperative interventions might reduce the incidence of a PMD and improve long-term outcome after HFR.

**Key points**
- In this three-hospital study, perioperative myocardial ischaemia with troponin Ic (TnIc) release occurs in 26.7% patients during the course of HFR.
- TnIc elevation was independently correlated with both late mortality and late cardiac morbidity with a 6.6-fold increase in the incidence of MCC and a 3.6-fold increase in the incidence of all-cause mortality.
- These results confirm that the onset of this cardiac morbidity appears early in HFR course.

**Conflicts of interest**
There are no conflicts of interest to declare.

**Supplementary data**
Supplementary data are available at *Age and Ageing* online.

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**References**


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‘Attended alone’ sign: validity and reliability for the exclusion of dementia

SIR—The diagnosis of dementia according to DSM-IV-TR criteria is based on clinical findings [1]. NINCDS–ADRDA criteria for Alzheimer’s disease (AD) are clinically based and supported by investigation findings [2]. Proposed new diagnostic criteria for AD attempt to incorporate biomarkers, but not all of these may be easily available outside major research centres [3]. Hence, the need remains for simple, reliable, valid tests based on clinical assessment to confirm or exclude the diagnosis of dementia.

The importance of collateral history from a knowl-edgeable informant when assessing individuals complaining of memory problems and in the diagnosis of dementia