Continuous 12-Lean ECG Monitoring to Detect the Need for Rescue Percutaneous Coronary Interventions In Acute Myocardial Infarction

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Abstract

Coronary Care Units lacking in hemodynamic facilities still rely on fibrinolytic therapy as the first line therapy of ST-elevation acute myocardial infarction. Patients not responding to therapy must receive rescue coronary angioplasty. On the basis of continuous 12-lead ECG monitoring we selected four patterns of response to therapy: 1) early and sustained reduction (>50% from baseline) of ST segment elevation was associated to patent infarct related artery ($p<0.001$) at coronary angiography before hospital discharge; 2) ST segment instability, 3) new sustained elevation after initial resolution, 4) persistent ST elevation were related ($p<0.001$) to occluded IRA. 2), 3), 4) patients received rescue PCI. In-hospital (3%) and 1-month (5.8%) mortality and 1-month (6.4%) heart failure were low and not significantly different in the four groups, confirming the clinical usefulness of this approach.

1. Introduction

Effective reperfusion is mandatory in ST-elevation acute myocardial infarction (STEMI). In Coronary Care Units (CCU) lacking in hemodynamic facilities, many patients without cardiogenic shock, pulmonary edema or acute mechanical complications can be effectively treated with fibrinolytic therapy (FT). However, those who don't respond to therapy must receive rescue coronary angioplasty (PCI) as soon as possible [1]. We describe our experience in the use of non invasive 12-lead ECG continuous monitoring as the elective strategy to select such patients.

2. Methods

2.1. ECG Monitoring

Since 1994, we have gained a lot of experience with Mortara ST-Surveyor bedside unit and central station, a 12-lead ECG monitoring system which allows a real-time continuous non invasive bedside evaluation of the clinical course of STEMI. The monitoring begins as soon as the patient is admitted to the CCU, and continues until hospital discharge. Data from all the 12 leads are continuously collected and every minute averaged over the last 10" of each minute. From these averages a ST trend for each lead is constructed, stored and displayed on-line. ST-segment changes have been measured at the J point + (1/16 x RR interval). During the hyperacute phase there is continuous evaluation by the nurses of the most involved lead, with snapshot 12-lead evaluation at 30', 60', 90' and 180' from the onset of monitoring (beginning of FT). The assessment of reperfusion has been usually made on the entity of ST segment evolution from baseline elevation to 90'. A reduction in ST segment elevation by more than 50% in the leads with maximal elevation has been considered a marker of reperfusion; subgroup analysis has been performed in patients with >70% reduction from baseline. However, in individual patients, decision making has been influenced by the dynamic ECG evolution at earlier times (mainly 60') combined to clinical parameters (chest pain, development of left ventricular insufficiency, major arrhythmias), and by a careful observation of dynamic changes at a later time (180' to 240').

2.2. Study Population

Between January, 2001 and April, 2003 we admitted 209 patients with STEMI; 24 (11%), with contraindications to FT or extensive MI complicated by shock or pulmonary edema received primary PCI in a tertiary care center. Among the remaining 185 we analyzed four distinct ECG pattern to evaluate the response to FT (45% alteplase, 55% tenecteplase). A) 95 (45%) had an early (within 90 minutes) and sustained reduction (>50%) of ST segment from baseline elevation; in 58 (A1) the reduction was >70%. B) 57 (27%) showed early reperfusion followed by ST-segment instability due to relapsing ischemia. C) 18 (8%) had new sustained ST elevation after initial reperfusion. D) 15 (7%) showed no reperfusion with persistent ST elevation. A) received elective coronary angiography and PCI if indicated before hospital discharge. C) and D) were sent to rescue

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PCI. In B) the timing of coronary angiography was chosen on the basis of clinical status and response to medical therapy. Among the other therapies of the hyperacute phase, 94% of the patients received aspirin, 92% intravenous unfractionated or subcutaneous low molecular (preceded by an i.v. bolus) heparin, 88% i.v. nitrates, 72% i.v. atenolol.

3. Results

Infarct-related artery (IRA) was patent in a higher percentage of group A patients, above all in the A1 subgroup (Table 1). Thus, A) group was significantly related to a patent IRA ($p<0.001$) while C) and D) groups were related to occluded IRA ($p<0.001$). However, early and medium term prognosis was favorable in all the groups, likely due to the selection of the patients to rescue PCI, confirming the clinical usefulness of this strategy. Thus, even if A and A1 groups had the lowest incidence of major adverse cardiac events, their low absolute number did not allow to reach statistical significance between groups (Table 2 and Table 3)

Group	%IRA patency
A	78
A1	86
B	65
C	22
D	13

Table 1: patency of IRA at coronary angiography, although performed at different times during the hospital phase (during the first hours from the onset of symptoms in groups C, D and B; deferred to the subacute phase in group A).

Group	% mortality
A	1
A1	0
B	2
C	5
D	6

Table 2: early (in-hospital) mortality. All p= n.s.

Group	% mortality	% heart failure
A	2	1
A1	1	1
B	4	9
C	9	14
D	14	11

Table 3: medium-term (1-month) incidence of mortality and clinical heart failure. All p = n.s.

4. Discussion

It is likely that in the near future most patients with STEMI will be treated with primary PCI. However, in most institutions the present scenario is different. An adequate technical equipment, operators' skillness and experience, availability of surgical standby are still a prerogative of only a few tertiary care centers [2]. Apart from selected subgroups (those patients presenting with cardiogenic shock, severe heart failure, significant left ventricular dysfunction due to previous MI, early mechanical complications) and in the absence of contraindications FT, above all if administrated early from the onset of symptoms, is an equally effective alternative [1,3]. However, whatever the therapy, what is mandatory is to achieve an effective reperfusion of the IRA. That is, it is crucial to recognize those patients not responding to therapy who benefit by rescue PCI. Continuous 12-lead ECG monitoring has been validated as an effective tool to monitor the effectiveness of reperfusion during FT [4,5], and we used it to select the patients to send to the tertiary care center. Our experience confirms previous data [4] showing an excellent prognosis in those having early (within 60') and sustained ST resolution (>50% from baseline, ideally >70%). We also underline the importance of a continuous dynamic evaluation of ST evolution, which reflects the physiopathologic interplay between acute thrombosis in the IRA, microvascular damage (no-reflow phenomenon) and stuttering damage to the jeopardized myocardium at risk [6]. That is, a second snapshot evaluation at 90'-120' gives further information on the response to therapy and allows patients' triage, sending the non-responders (group D, those showing persistent ST elevation), to rescue PCI. The observation must be extended further to 180' and more to include the more dynamic patterns of new sustained elevation after initial reperfusion (group C) and ST segment instability (group B), both likely to benefit from an early invasive approach. The speed, extent and persistency of ST segment resolution give indipendent informations and allow different treatment strategies in patients with STEMI first treated with FT [3], selecting high-risk patients whose prognosis may be improved turning to rescue PCI, without wasting precious time, in the very early hours of evolving STEMI.

5. Conclusion

Primary angioplasty is probably the elective therapy of STEMI in the near future. In the present daily practice of a CCU admitting hundreds of STEMI patients every year, but lacking in hemodynamic facilities, a dynamic

monitoring of reperfusion (that is, effectiveness of ongoing FT) with real-time continuous 12-lead ECG allows an adequate patients' triage. It is able to select between on-site adequate and effective treatment and treatment failure with need of rescue PCI, preserving early and medium-term prognosis in the overall population of STEMI patients.

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