Introduction and objectives. The aim of this study was to determine the duration of complete atrioventricular block complicating inferior wall acute myocardial infarction after the administration of fibrinolytic therapy.

Patients and method. From 1 January 1992 to 31 January 2002 a total of 449 patients were admitted directly to our hospital with inferior wall acute myocardial infarction in the first 6 hours; 282 of them (64%) received fibrinolytic therapy. Complete atrioventricular block appeared in 39 of these 282 patients (13.8%, group A). Of the 167 patients who did not receive thrombolytic therapy, complete atrioventricular block appeared in 13 (8%, control group). We compared the two groups by analyzing the duration of heart block, time to appearance, hemodynamic repercussion, and treatment required.

Results. On admission, 38% of the patients in group A and 61% (P=NS) of those in the control group had complete atrioventricular block. Median duration of the block was 75 minutes (10 minutes to 48 hours) in group A and 24 hours (15 minutes to 9 days) in the control group (P=.004). After fibrinolytic therapy was administered, median duration of the block was 45 minutes (5 minutes to 48 hours). A temporary pacemaker was implanted in 43% of the group A patients and 84.6% of the control group patients (P=.01).

Conclusion. Complete atrioventricular block appears as a complication of inferior myocardial infarction within the first hours after the event. Duration of the block seems to be shorter in patients treated with fibrinolytic therapy.

Key words: Myocardial infarction. Pacemakers. Heart block. Fibrinolysis.

Duración del bloqueo auriculoventricular completo en el infarto inferior tratado con fibrinólisis

Introducción y objetivos. El objetivo de nuestro estudio es determinar la duración del bloqueo auriculoventricular completo (BAVC) en el transcurso de un infarto agudo de miocardio (IAM) de localización inferior tras la administración de tratamiento fibrinolítico.

Pacientes y método. Entre el 1 de enero de 1992 y el 31 de enero de 2002 consultaron en primera instancia en nuestro centro 449 pacientes con IAM de localización inferior en las primeras 6 h de evolución. El 64% (282 pacientes) recibió fibrinólisis. En este grupo, 39 (13,8%) pacientes presentaron BAVC (grupo A). En los 167 pacientes no tratados con trombolítico, 13 (8%) casos presentaron BAVC (grupo control). Se comparan ambos grupos y se analizan la duración y presentación del bloqueo, la repercusión hemodinámica y la conducta terapéutica seguida.

Resultados. En el 38% de los pacientes del grupo A había BAVC en el momento del ingreso frente al 61% de los del grupo control (p = NS). La duración mediana del bloqueo fue de 75 min (10 min-48 h) en el grupo A y de 24 h (15 min-9 días) (p = 0,004) en el grupo control. Una vez realizada la fibrinólisis, el BAVC tuvo una duración mediana de 45 min (5 min-48 h). Se implantó un marca-pasos provisional en 17 pacientes del grupo A (43%) y en 11 del grupo control (84,6%) (p = 0,01).

Conclusión. El BAVC en el IAM de localización inferior aparece precozmente. La duración del bloqueo parece ser menor al realizar la fibrinólisis.


INTRODUCTION

Atrioventricular conduction problems are a common complication of acute myocardial infarction (AMI) involving the inferior wall. These complications are associated with increased mortality.1,7 and
are therefore a sign of poorer prognosis. In the pre-thrombolytic era, the incidence of advanced atrioventricular block in inferior wall AMI was some 19%. Although this has been reduced to 11%-12% since the introduction of fibrinolytic treatment, it remains one of the most important complications. The efficacy of fibrinolytic treatment is greater the earlier it is provided. In inferior wall AMI with complete atrioventricular block (CA VB), the dilemma of whether to implant a provisional pacemaker—a course of action that might delay the start of fibrinolytic treatment—is often faced. Implantation also involves a risk of hemorrhage at the puncture site.

The literature contains information on the incidence and development of CA VB in inferior wall AMI in the pre-thrombolytic era, but the duration of CA VB in fibrinolysis-treated patients has not been reported. The aim of the present work was to analyze the development and characteristics of CA VB in patients admitted with inferior wall AMI who were candidates for fibrinolytic treatment, and to compare the results with those of patients who received no such treatment.

**RESULTS**

**Patient Characteristics**

The mean age of the 39 patients of group A was 61±12 years. Of these patients, 35 (89%) were men. The mean age of the control group (group B) was 67±12 years; 9 (69%) were men (P=NS). Table 1 shows all the patient characteristics recorded.

**Characteristics of the Acute Myocardial Infarction Suffered**

In group A, 16% of patients presented with a Killip class III-IV AMI; in group B 54% of the patients pre-
sent with an AMI of these characteristics \((P=.02)\) (Table 2).

The right ventricle was involved in 17 group A patients \((41\%)\), although only in 12 \((30\%)\) was there a significant clinical repercussion. All patients showed increased enzyme levels. The CK peak was 3.304±2.077 U/L and the CK-MB peak 335±117 ng/mL.

The right ventricle was involved in 5 group B \((38\%)\) patients. The CK peak was 2.894±2.161 U/L and the CK-MB peak 261±158 ng/mL. No significant differences were seen between the 2 groups. The determination of troponin levels was not standard practice for most of the study period; these data are therefore not shown.

### Fibrinolytic Treatment

The mean time elapsed between the onset of pain and arrival at the emergency department was 80±53 min for group A and 137±73 min \((P=.004)\) for group B. The mean time elapsed between the onset of pain and the start of fibrinolytic treatment in group A was 151±67 min. The thrombolytic agents used were streptokinase \((73\%\) of cases), tissue plasminogen activator \((19\%\) of cases) or other agents \((8\%\) of cases).

### Characteristics and Treatment of Atrioventricular Block

Of the 39 patients in group A, 15 \((38\%)\) showed CAVB on arrival, as determined by the initial ECG. In group B, CAVB was noticed in the initial ECG of 8 patients \((62\%)\) \((P=NS)\). Of the 24 remaining patients in group A, the mean time to the start of CAVB since the onset of pain was 150 min \((\text{range, 45 min to 48 h})\). In 84\% of cases, CAVB appeared in the first 3 h following the onset of pain. In 2 patients, CAVB appeared 48 h after pain onset, without being preceded by further chest pain or re-elevation of the ST segment.

In group A, the median duration of CAVB was 75 min \((P_{25} 15 \text{ min}, P_{75} 120 \text{ min})\) \((\text{range, 10 min to 48 h})\); in group B, CAVB lasted a median of 1440 min \((P_{25} 15 \text{ min}, P_{75} 5760 \text{ min})\) \((\text{range, 15 min to 9 days})\) \((P=.004)\). When fibrinolysis was begun, the CAVB rapidly reverted to sinus rhythm. The median duration of the block from the time thrombolysis began was 45 min \((\text{range, 5 min to 48 h})\). Omitting the patient in whom CAVB lasted 48 h, the mean duration of blockage after the start of fibrinolysis was 51 min. In 69\% of group A patients the duration of CAVB was <2 h, while in 50\% of group B patients it lasted more than 24 h, and in 77\% more than 4 h (Figure).

Decisions on the pharmacological management of the patients and the need to implant a provisional pacemaker were taken by the attending physician \((\text{no guidelines on the treatment of AMI were available from the Sociedad Española de Cardiología until 1999})\). In group A, 18 patients \((46\%)\) received atropine and 3 \((16.6\%)\) reverted to sinus rhythm. Six patients \((15\%)\) received dopamine, 4 of whom \((66\%)\) recovered their sinus rhythm with 1:1 conduction in a short time. Only 2 patients received an intravenous perfusion of isoproterenol for extreme bradycardia \((<40 \text{ beats/min})\). Although this did not revert the CAVB, the ventricular escape rate was improved and a provisional pacemaker implanted. Atropine was administered to 23\% of group B patients \((P=NS)\) but in only 1 was the CAVB reverted to sinus rhythm. Eight of these patients \((61\%)\) were administered dopamine and 2 received isoproterenol \((P=NS)\).

In group A, 17 patients \((43\%)\) were intravenously implanted with a provisional electrosheath whereas in group B 11 patients \((84.6\%)\) required this procedure \((P=.01)\). In 12 \((30\%)\) of the 39 group A patients, CAVB was present with low blood pressure \((\text{systolic blood pressure } <90 \text{ mm Hg})\) and severe bradycardia \((\text{heart rate } <40 \text{ beats/min})\); no response to atropine was observed. All 12 were implanted with a provisional pacemaker. In the remaining 5 patients, the electrosheath was implanted as prophylaxis against CAVB-associated hemodynamic deterioration. In group B, 10 of the 11 patients who needed transitory stimulation
showed clear hemodynamic deterioration (low blood pressure and severe bradycardia). In the remaining patient, prior serious syncope was taken to indicate the need for a pacemaker.

In all group A patients, access was possible via the femoral vein (mostly the right). In four of the 17 above patients (23%), the pacemaker was implanted before fibrinolytic treatment. In group B, access was obtained via the right internal jugular vein in four patients, and via the femoral vein in the rest.

Evolution of CAVB

In the majority of group A patients, the temporary pacemaker was removed after 48 h, when sinus rhythm and 1:1 conduction had been recovered and maintained for at least 24 h. No patient required a permanent pacemaker. No significant difference was seen in the time to the recovery of sinus rhythm between the patients who showed hemodynamic deterioration with CAVB and those who tolerated the block better. In group B, the long duration of CAVB (in 5 patients it lasted more than 4 days), required the electrophys to be maintained in place for longer (in 1 patient for 10 days). One patient required the implantation of a permanent pacemaker.

In 1 of the group A patients who presented with ventricular tachycardia (VT), ventricular fibrillation (VF) occurred during the implantation of the provisional electrophys. This was probably associated with the procedure since its onset coincided with the moment when contact was made between the electrode and the tricuspid valve. Electrical defibrillation (200 J) was effective and the patient showed no clinical sequelae. Two group A patients (11.7%) showed a large femoral hematoma that necessitated a blood transfusion due to a greater than 10 point fall from the baseline hematocrit value. In both cases the hematoma was resolved with conservative treatment without the need for surgical drainage. None of the group B patients experienced complications due to the implantation of the provisional pacemaker ($P=\text{NS}$).

The in-hospital mortality was 12.8% ($n=5$) in group A and 46% ($n=6$; $P=0.03$) in group B. In group A, 3 patients died of refractory cardiogenic shock and two of electromechanical dissociation. All were in sinus rhythm at the moment of death. In group B, 4 patients died of refractory cardiogenic shock (all with unresolved CAVB at the moment of death), 1 due to VF that degenerated into asystole, and 1 of septic shock due to acute peritonitis (after having recovered sinus rhythm).

DISCUSSION

A number of studies have analyzed the incidence of CAVB and its effect on the prognosis of patients with inferior wall AMI, both in the pre-thrombolytic era and later when fibrinolysis had become a standard procedure. However, little information is available on the characteristics and duration of CAVB in patients receiving fibrinolytic treatment, or on the therapeutic approach to be followed in these cases. Until now, the work of McNeaill et al involved the largest group of patients ($n=21$). In the present work, however, group A was comprised of 39 patients, all with inferior wall AMI complicated by CAVB. This was appreciable in the initial ECG of 43% of these patients. The majority received fibrinolytic treatment within two hours of onset. Similar presentation data have been recorded in other studies, including the TIMI II study, in which 54% of patients presented with CAVB at admission, and the study by Melgarejo et al, in which 67% of patients showed CAVB at admission or within the next hour.
Although the incidence of CAVB was similar in both the present groups it was significantly shorter lasting in those patients who received fibrinolysis (group A) than in those who did not (group B) (median 75 min compared to 1440 min respectively; \( P=0.004 \)). Despite the small number of patients in this study, this finding is of clinical interest since it supports the idea that thrombolysis should be attempted in patients with inferior wall AMI plus CAVB as a means of quickly resolving this complication. Indeed, if rapid resolution can be expected, the use of more aggressive techniques such as the implantation of a provisional electrotrode catheter (which is not free of risk) might be avoided.

In the present study, once the fibrinolytic treatment had been administered, the CAVB reverted rapidly and sinus rhythm and 1:1 conduction were restored in little more than an hour in around half of the patients, and in under two hours in 69%. These data agree with those of McNeaill et al., who reported the reversion of CAVB in 52% of patients within the first 2 hours of initiating thrombolysis, and with those of the TAMI study, which reported CAVB to last a mean of 2.5 h and under 12 h in 75% of patients.

In the present patients, the administration of atropine (a class I indication in the Sociedad Española de Cardiología guidelines) achieved a reversion of CAVB and 1:1 conduction in 16.6% of group A patients, and in 33% of group B patients. These are not inappreciable results given the few adverse effects associated with such treatment; in our opinion, atropine treatment should always be initially attempted unless there are clear contraindications. The administration of dopamine or isoproterenol is not contemplated in the above guidelines, nor is their use mentioned in other studies. In the present work, dopamine was administered to only a small number of patients, but sinus rhythm was achieved in 66% of those in group A. This drug might be of use in inferior wall AMI with symptomatic CAVB, especially at centers where provisional pacemakers cannot be implanted. Dopamine and isoproterenol can increase the frequency of the ventricular escape rhythm and induce mild clinical and hemodynamic improvement. However, the results of the present and other studies show that they only rarely revert CAVB on their own.

In the majority of patients who received fibrinolysis, CAVB was relatively well tolerated. Only 30% of the present patients showed significant hemodynamic deterioration (hypotension and severe bradycardia) without response to atropine. These patients received a provisional electrotrode catheter, and their clinical situations improved with the increase in heart rate induced by the pacemaker.

The efficacy of fibrinolysis as a treatment for inferior wall AMI has been demonstrated, the benefits being greater the earlier this treatment begins. The implantation of a provisional electrotrode catheter could cause a delay in starting fibrinolytic treatment—a delay could be longer for patients initially treated at small hospitals who are then referred to larger centers for a provisional pacemaker to be implanted. Thrombolytic treatment is probably the most efficient in the reversion of CAVB; tardy initiation could delay the reperfusion of the atrioventricular node, the ischemia of which could, hypothetically, be related to the physiology of CAVB. As a consequence the duration of CAVB would be longer.

In the present study, provisional pacemakers were implanted in 43% of group A patients (17 out of 39). However, the number so treated differs widely between similar studies, e.g., in the study performed by Melgarejo et al., 58% of patients received a temporary pacemaker, whereas only 17% received the same in the study performed by McNeaill et al. Twelve of our 17 group A patients (30%) showed severe bradycardia and hypotension, which suggests the implantation of an electrotrode catheter was advisable. However, the results of this study show that such a course of treatment for the other 5 is questionable. The implantation of a provisional pacemaker was required more often in group B patients, who received no thrombolytic treatment (84.6% compared to 43%; \( P=0.01 \)). In this group, a large majority showed considerable hemodynamic deterioration (hypotension and severe bradycardia), and the duration of CAVB was significantly longer.

Transvenous transient cardiac stimulation in a patient who has received, or is shortly to receive fibrinolytic treatment, is not free of complications. In the present study, 2 patients (11.8%) developed a femoral hematoma (resolved with local pressure) that necessitated a blood transfusion. McNeaill et al. did not report this complication, although Melgarejo et al. reported 3.6% of their patients to suffer the same. Although the maximum thrombolytic effect does not coincide with the implantation of the electrotrode catheter, the risk of hemorrhage persists for some 24-48 h after the procedure, owing to the effects of coadjuvant therapy with heparin and anti-aggregation drugs.

The implantation of a provisional electrotrode catheter is also associated with a risk of potentially lethal arrhythmias in about 3.6% of cases. In group A, 1 patient (5.8%) had a VT that degenerated into VF during the implantation of the electrotrode catheter; this occurred when the electrode came into contact with the tricuspid valve. The situation was resolved with defibrillation. There is also a risk that the electrotrode catheter might perforate the ventricle. Some studies estimate this to occur in 4% of cases, but it could be more common in patients with an AMI involving
the right ventricle since the tissue is less robust. No patient suffered this complication in the present study, nor were any so affected in the studies of Melgarejo et al\textsuperscript{6} or McNeaill et al.\textsuperscript{8}

An alternative to the transvenous electrocatheter procedure is to use a transcutaneous pacemaker. However, this is a very painful technique and generally requires intense analgesia, perhaps even pharmacological sedation, which could cause the patient to deteriorate. It should therefore only be used when there is hemodynamic deterioration (hypotension and severe bradycardia), and when there is insufficient infrastructure to allow the immediate implantation of a provisional, transvenous electrocatheter.

**Limitations of the Study**

The present work is an observational study in which the control group is small (patients admitted with an AMI involving the inferior wall within the last 6 h, complicated by CAVB, and who received no fibrinolytic treatment). Over the 10 year study period, no further patients who met the inclusion criteria were available at our hospital; since the year 2000, all AMI patients have received thrombolysis or angioplasty within the first 6 h of an AMI unless clearly contraindicated. Even so, the study is of clinical interest since it provides information on the duration of CAVB in patients who are candidates for fibrinolysis—it is these cases that present the greatest doubts about which therapeutic course to follow. However, the very fact that significant results were obtained even though the numbers were small, underlines the value of the conclusions.

**CLINICAL IMPLICATIONS**

Given the present results, and those of other authors, the duration of CAVB in inferior wall AMI is brief when treated by fibrinolysis. This complication lasts a significantly shorter length of time when thrombolysis is performed than when no reperfusion therapy is followed. The mortality associated with the above condition is also lower when such treatment is provided. Thus, fibrinolytic treatment should be provided early in CAVB.

In the present study, thrombolytic treatment led to fewer patients requiring a provisional pacemaker. Given the short duration of CAVB, transitory stimulation of the heart via intravenous access should be reserved for patients with poor hemodynamic tolerance (patients with CAVB and low ventricular frequencies, hypotension, and/or cardiogenic shock), since this technique is not free of complications.

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