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Research Article

Accelerated Idioventricular Rhythm in Acute Coronary Syndrome with ST Segment Elevation: Clinical Significance

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Abstract:

Background: Accelerated Idioventricular rhythm in acute coronary syndrome with ST segment elevation is common after thrombolysis and it is relatively benign; its occurrence is considered as a sign of reperfusion of the occluded coronary artery.

Aims: The main objective of our study is the determination of the frequency of Accelerated Idioventricular rhythm in acute coronary syndrome with ST segment elevation after thrombolysis, the secondary objective is checking with coronary angiography if this rhythm really means the success of thrombolysis and reperfusion of the occluded coronary artery.

Methods and materials: In this prospective study, conducted in the cardiology department of Hussein Dey hospital (Algiers-Algeria), 467 patients with acute coronary syndrome with elevated ST segment (87 women and 380 men) were enrolled between 28 February 2014 and 16 July 2015. The average age is 60 ± 13 years; at admission, a Holter recorder was attached in 448 patients, for continuous ECG monitoring during 48 hours, coronary angiography was performed in 329 patients.

Kruskal's ANNOVA or H tests were used for comparison of quantitative variables, $\chi 2$ test or Fisher's exact test, were used for qualitative variables, all tests were performed with 1st species risk of 5%.

Results: The frequency of Accelerated idioventricular rhythm recorded by the Holter ECG is 17.2 % (77 patients), CI 95%: [13.7%-20.7%], this frequency is 18.71 % (73 patients) CI 95%: [14.8 %-22.6%] in patients undergoing thrombolytic treatment.

There is no significant difference between the frequencies of persistence of chest pain in the groups of patients with or without accelerated idioventricular rhythm after thrombolysis: 5.47 % (4 patients) versus 5.99 % (19 patients) respectively, p = 0.979; also for the frequencies of persistence of ST segment elevation after thrombolysis: 4.10 % (3 patients) versus 6.94 % (22 patients) respectively, p = 0.476).

The frequency of occluded coronary artery (TIMI 0) is low in group of patients with accelerated idioventricular rhythm 14.51 %, (9 patients) compared to group of patients without this rhythm 21.39 % (52 patients), but the difference isn't significant (p= 0.227).

Conclusion: Accelerated idioventricular rhythm is common in acute coronary syndrome with elevated ST segment and generally considered as a sign of reperfusion; in our study, this rhythm may occur even in the absence of reperfusion of the occluded coronary artery and does not necessarily mean reperfusion or success of thrombolysis.

Key words: Acute Coronary Syndrome, accelerated idioventricular rhythm, thrombolysis, occluded coronary artery.

Introduction

Accelerated idioventricular rhythm (AIVR) in acute coronary syndrome with ST segment elevation, is common and relatively benign; known as sign of reperfusion of the occluded coronary artery. [1]

Accelerated idioventricular rhythm is transient, self-terminating arrhythmia originating in Purkinje network or ventricular myocardium, its rate varies between 40 and 100 beats/min.

After acute coronary artery with ST segment elevation, ischemia and reperfusion are regarded as the principal mechanisms of AIVR; the electrophysiological mechanism is probably enhanced automaticity. [1][2]

The main objective of our study is to determine the frequency of Accelerated idioventricular rhythm in acute coronary syndrome with ST segment elevation, during the first 48 hours of hospitalization, while the secondary objective is checking with coronary angiography if this rhythm really means the success of thrombolysis and reperfusion of the occluded coronary artery.

Methods and materials

We prospectively studied a group of 467 consecutive patients (380 men and 87 women; mean age 60 ± 13 years) who presented acute coronary syndrome with ST segment elevation and admitted in cardiology department of Hussein-Dey hospital (Algiers, Algeria), between 28th February 2014 and 16th August 2015.

At emergency department admission, an ECG Holter recorder was attached in 448 patients for continuous ECG monitoring during 48 hours, the 17-leads surface ECG recorded at admission and repeated during hospitalization, Doppler Echocardiography, coronary angiography, and biological assessment were performed in the majority of patients.

The most important rhythm and conduction disorders were identified, the patients with the same type of disorder are grouped together, and the name assigned to each group is that of the disorder that characterizes it; there are overlaps between the groups, so that several disorders may exist in the same patient.

The constitution of each group of the rhythm disorder implies the constitution of the opposite group without the corresponding disorder, the latter group is used for the comparative study; each group is therefore described and then compared to the corresponding opposite group.
In this sub study, the group of patients with Accelerated idioventricular rhythm was compared to the rest of patients without Accelerated idioventricular rhythm

Statistical analysis

Data are presented as mean ± SD, median, or frequency (percentage) where appropriate. Continuous variables were compared using the ANNOVA test, or H Kruskal Wallis test. $\chi 2$ tests and Fisher's exact test were performed to distinguish differences between categorical variables. Statistical significance was defined as $p < 0.05$; the statistical analysis was performed using SPSS Statistics (release 17).

Results

The frequency of Accelerated idioventricular rhythm recorded by the Holter ECG is 17.2 % (77 patients), CI 95%: [13.7%-20.7%], this frequency is 18.71 % (73 patients) CI 95%: [14.8 %--22.6%] in patients undergoing thrombolytic treatment, four patients had presented AIVR without the administration of thrombolytic drugs.
This group of patients included nine women and sixty-eight men. The mean age was 58.44 ± 11.18 years; the extreme age was 29 and 85 years.
AIVR was observed immediately after administration of thrombolytic drugs, its mean rate is about 80 beats/min, and its duration doesn't exceed 3 hours. (Figure 1)

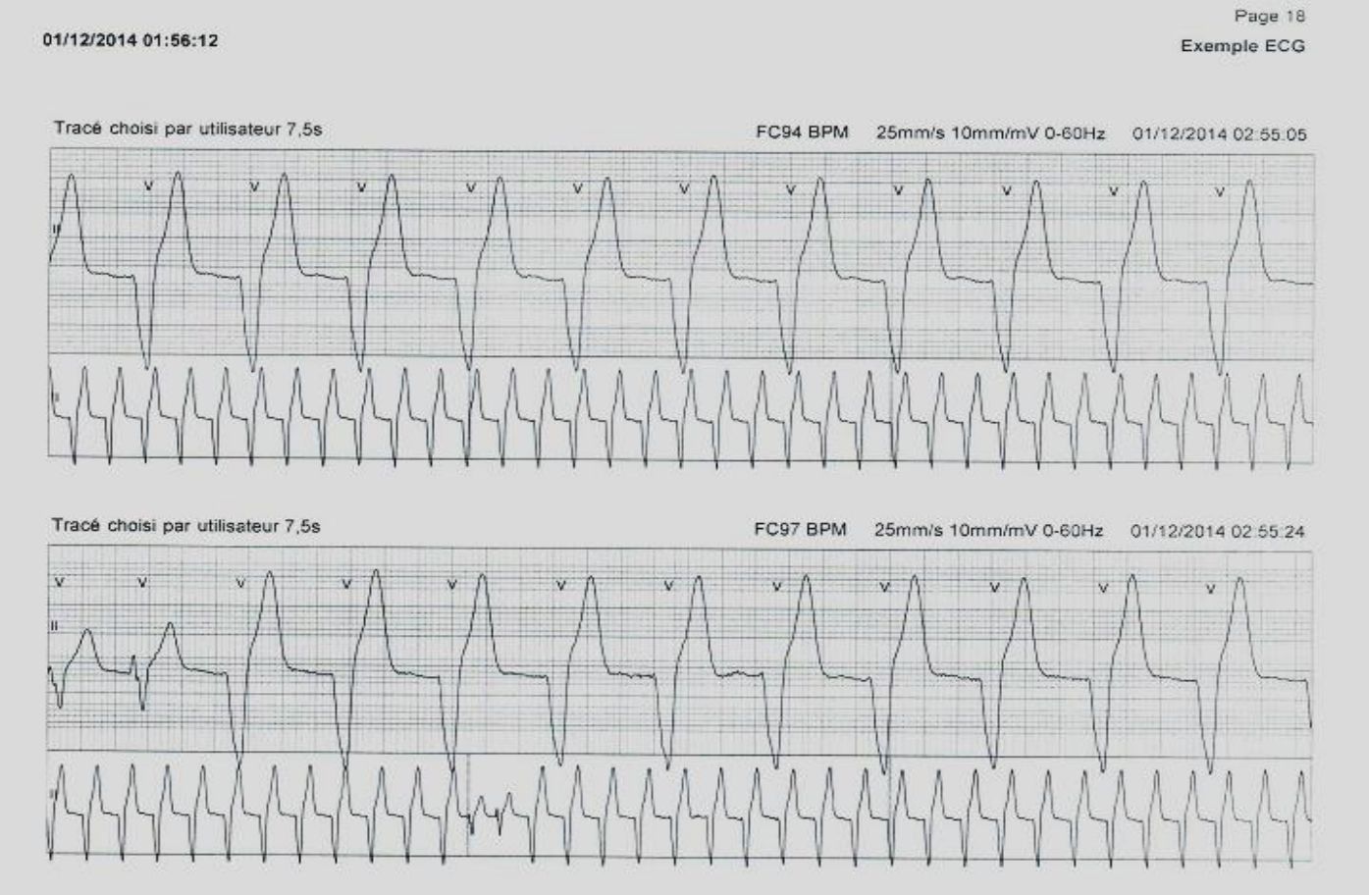

Figure 1: Holter ECG showed Accelerated idioventricular rhythm after thrombolysis in anterior acute coronary syndrome with ST segment elevation

Cardiovascular risk factors, clinical characteristics, medical history, treatment and evolution are shown in Table 1.
The Surface ECG had shown, anterior ACS in 2 patients, infero-basal in 26 patients, inferior in 6 patients and right in 9 patients.
The mean heart rate at admission was 78.47 ± 18.16 beats/min, the mean PR interval was 141.39 ± 28.34 msec, the mean duration of the QRS complex at admission was 69.87 ± 15.43 msec, the mean amplitude of the ST segment elevation was 4.74 ± 3.109 mm, the mean amplitude of the ST segment depression was 1.32 ± 0.85 mm, the mean amplitude of the T wave was 7.79 ± 4.184 mm and the mean corrected QT was 409.11 ± 39.53 msec.

Table 1: Characteristics of the study patients (N=448 patients)				
	Patients with AIVR (N= 77)	Patients without AIVR (N== 371)	P-value	
Mean age	58.44	60.30	0.224	NS
Females	9	74	0.090	NS

Early consultation (within 6 hours)	**67/77**	**260/371**	**0.002**	**S**
Hypertension	27/77	171/371	0.079	NS
Diabetes type 1	0/77	13/371	0.096	NS
Diabetes type 2	18/77	118/371	0.143	NS
Current smoking	**4/77**	**53/371**	**0.031**	**S**
hyperlipidemia	12/77	54/371	0.838	NS
GRACE score ≥ 155	21/77	134/371	0.305	NS
Cardiogenic shock	1/77	14/371	0.272	NS
Left ventricular heart failure	9/77	49/371	0.718	NS
Right ventricular heart failure	0/77	9/371	0.167	NS
Persistence of chest pain after thrombolysis	4/73	19/317	0.979	NS
Hospital mortality (first 48 hours)	0/77	13/371	0.999	NS
Electrocardiogram				
Right ventricular ACS	9/77	31/371	0.351	NS
Anterior ACS	**2/77**	**41/371**	**0.022**	**S**
Inferior ACS	6/77	72/371	0.014	S
Infero basal ACS	26/77	83/371	0.034	S
Heart Rate at admission	78.47	83.26	0.064	NS
Mean PR interval at admission	141.39	141.18	0.954	NS
Mean QRS duration at admission	69.87	74.63	0.061	NS
Mean ST segment elevation	**4.74**	**4.04**	**0.031**	**S**
Mean ST segment depression	1.32	1.25	0.576	NS
Average QTc	409.11	418.54	0.083	NS
Mean amplitude of the T wave at admission	7.79	7.06	0.152	NS
Persistence of ST segment elevation	3/77	24/371	0.385	NS
Persistence of ST segment elevation after thrombolysis	3/73	22/317	0.476	NS
Hospital mortality	0/77	13/371	0.096	NS
Medication before ACS				
Beta blockers	4/77	31/370	0.344	NS
ARB	8/77	56/370	0.279	NS
ACE-inhibitor	4/77	29/370	0.420	NS
Lipid-lowering drugs	2/77	30/370	0.088	NS
Antiplatelet agents	3/77	34/370	0.125	NS
Treatment at admission				
Thrombolysis	**73/77**	**317/371**	**0.026**	**S**
Primary or rescue percutaneous coronary intervention	2/77	5/371	0.421	NS
Beta blockers	32/77	151/371	0.889	NS
ACE-inhibitor	43/77	211/371	0.868	NS
Amiodarone	7/77	28/371	0.646	NS

External electric shock	2/77	20/371	0.302	NS
Echocardiography				
Mean Ejection fraction of left ventricle	50.08	49.87	0.864	NS
Mean left atrium surface	**15.56**	**16.84**	**0.007**	**S**
Mean right atrium surface	10.786	11.27	0.162	NS
Mean Diastolic diameter of left ventricle	54.47	53.99	0.531	NS
Mean Diastolic diameter of right ventricle	24.47	24.78	0.519	NS
Akinetic segment	47/76	215/356	0.814	NS
Significant mitral insufficiency	4/76	26/354	0.507	NS
Mean systolic pulmonary arterial pressure	**25.97**	**27.91**	**0.045**	**S**
Thrombus	2/75	8/355	0.829	NS
Coronary angiography				
Severe coronary artery lesions	14/67	82/251	0.062	NS
Left main coronary artery severe lesion	2/67	10/251	0.703	NS
Left anterior descending artery lesion	39/67	165/251	0.254	NS
Left circumflex coronary artery lesion	23/67	89/250	0.847	NS
Right coronary artery lesion	32/67	101/250	0.278	NS
TIMI flow grade 0	9/62	52/243	0.227	NS
ACS: Acute Coronary Syndrome, ACE inhibitors: Angiotensin-Converting Enzyme inhibitors ARB: Angiotensin Receptor-Blocker, QTc: Corrected QT interval.				

Treatment at admission and during hospitalization: Metalyse (Tenecteplase) as fibrinolytics treatment, were administered in 72 patients (93.50 %), 5 patients had presented AIVR without administration of fibrinolytics treatment.

Aspirin, Clopidogrel and Anticoagulants were administered in 77 patients (100 %), beta blockers in 32 patients (41.55 %), ACE inhibitors in 43 patients (55.84 %), external electric shock in 2 patients (2.59 %), Amiodarone in 7 patient (9.09 %), Magnesium and Potassium supplementation at admission in 46 patients (59.74 %), Insulin in 17 patients (22.07 %).

Thrombolysis failure: the persistence of chest pain after thrombolysis was observed in 4 patients and persistence of ST segment elevation after thrombolysis in 3 patients.

Doppler echocardiography was performed in 76 patients, the mean left ventricular ejection fraction was 50.08 % ± 8.577, the mean area of the left atrium: 15.561 ± 3.415 cm², the mean area of the right atrium: 10.786 ± 2.201 cm², the mean diastolic diameter of the left ventricle: 54.47 ± 5.55 mm, the mean diastolic diameter of the right ventricle was 24.47 ± 3.127 mm, the mean systolic pulmonary blood pressure: 25.97 ± 5.596 mm Hg, wall akinesia in 47 patients (61.84 %), and significant mitral insufficiency in 4 patients (5.26 %).

Holter ECG was performed in 448 patients; this exam had participated in the monitoring of AIVR, showed its characters rate and duration, and also detected associated arrhythmias.

Several arrhythmias were associated with AIVR, ventricular fibrillation (VF) in 2 patients, sustained ventricular tachycardia (SVT) in 2 patient, non-sustained ventricular tachycardia (NSVT) in 40 patients (Figure 2), atrial fibrillation (AF) in 6 patients, complete atrioventricular block in 2 patients, Sino atrial block in 2 patients, complete right bundle brunch block in 5 patients, bursts of atrial premature beats in 32 patients, bursts of ventricular premature beats in 54 patients, polymorphic ventricular premature beats in 16 patient, PVC with R on T phenomenon in 5 patients.

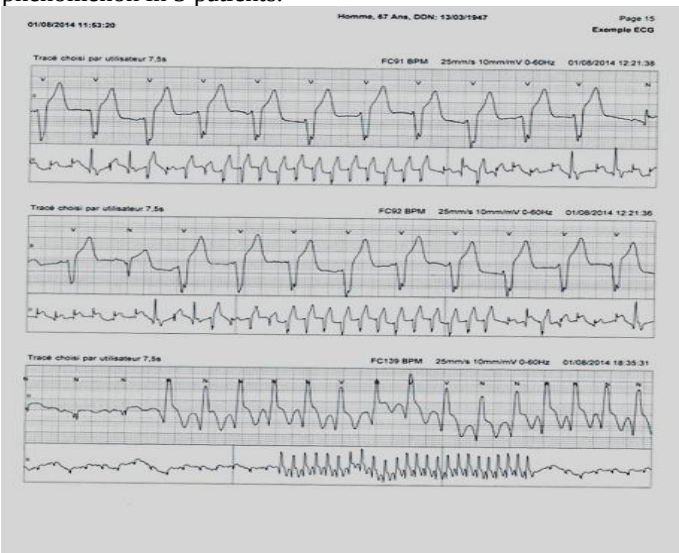

Figure 2: Holter ECG showed Accelerated idioventricular rhythm associated with non-sustained ventricular tachycardia after thrombolysis in anterior acute coronary syndrome with ST segment elevation

Coronary angiography was performed in 67 patients, severe coronary artery lesions were found in 14 patients (20.89 %), severe lesion of left main coronary artery in 2 patients (2.98 %), severe stenosis of the left anterior descending artery in 39 patients (58.20 %), circumflex artery in 23 patients (34.32 %), right coronary artery in 32 patients (47.76 %), TIMI flow grade 0 in 9 patients (14.51 %).

Biology: the average blood glucose: 1.54±0.74 g/l, average serum potassium 4.042 ± 0.48 mmol/l, average blood urea: 0.348± 0.134 g/l, blood creatinine: 11.67 ± 3.69 mg/l; High-Sensitivity Troponin (hs-Trop) above or equal 5 ng/ml in 29 patients (42.64 %).

Some variables were significantly associated with occurrence of AIV, such as early consultation, current smoking, high ST segment elevation, thrombolysis, less wide left atrium, low systolic pulmonary blood pressure. (Table 2)

Table 2: variables significantly associated with Accelerated idioventricular rhythm

	Patients with AIVR (N= 77)	Patients without AIVR (N=371)	P-value	
Early consultation (within 6 hours)	67/77	260/371	0.002	S
Current smoking	4/77	53/371	0.031	S
Mean ST segment elevation	4.74	4.04	0.031	S
Thrombolysis	73/77	317/371	0.026	S
Mean left atrium surface	15.56	16.84	0.007	S
Mean systolic pulmonary arterial pressure	25.97	27.91	0.045	S

But no significant association with the signs that reflect reperfusion such as the disappearance of chest pain, the decrease of the elevated ST segment, and coronary flow restoration checked by coronary angiography. (Table 3)

Table 3: Signs of reperfusion not significantly associated with Accelerated idioventricular rhythm

	Patients with AIVR (N= 77)	Patients without AIVR (N=371)	P-value	
Persistence of chest pain after thrombolysis	4/73	19/317	0.979	NS
Persistence of ST segment elevation after thrombolysis	3/73	22/317	0.476	NS
TIMI flow grade 0	9/62	52/243	0.227	NS

Discussion

Accelerated idioventricular rhythm (AIVR) in acute coronary syndrome with ST segment elevation, is common and relatively benign; known as sign of reperfusion of the occluded coronary artery. [1-3]

Accelerated idioventricular rhythm is a transient, self-terminating arrhythmia originating in Purkinje network or ventricular myocardium, its rate varies between 40 and 100 beats/min.

After acute coronary artery with ST segment elevation, ischemia and reperfusion are regarded as the principal mechanisms of AIVR; the electrophysiological mechanisms are probably enhanced automaticity and triggered activity. [4]

Biochemical and metabolic changes in reperfusion depend on the duration of ischemia.

The Na+ / Ca2+ exchanger, the slowly activating delayed rectifier K+ current and the phosphorylation of sarcoplasmic reticulum proteins, participate in intra cytoplasmic calcium overload which in turn causes early and late post depolarization, so the mechanism of reperfusion arrhythmias is mainly the triggered activity.[4]

The transition between the ischemic or reperfused zone and the non-ischemic zone plays a key role in the genesis of rhythm disorders. [4]

According to several studies, the incidence of AIVR varied between 15 and 90 % [3], it depends on the treatment strategy and method of monitoring; the frequency of 41 % was reported in patients treated with thrombolytic drugs [5], another study reported the frequency of 70 %, [6], the frequency is about 42 % in patients after primary percutaneous coronary intervention. [7]

In our study, the incidence of Accelerated idioventricular rhythm recorded by the Holter ECG is 17.2 % (77 patients), CI95%: [13.7%-20.7%], this frequency is 18.71 % (73 patients) CI95%: [14.8 %-22.6%] in patients undergoing thrombolytic treatment; this incidence is within the range of those reported in the literature; four patients had presented AIVR without receiving thrombolytic drugs.

According to several studies, AIVR is regarded as a sign of reperfusion, Ashar Khan et al, reported that early AIVR is a sign of successful thrombolysis ($p < 0.05$) with very good specificity (94%) and positive predictive value (94%) [5], another study showed that the combined analysis of early peak creatine kinase (CK) activity ≤12 h after the start of thrombolysis, ≥ 50% reduction in ST segment elevation, and occurrence of reperfusion arrhythmias within the 1st 90 min of thrombolytic therapy, predict the coronary artery patency in patients with acute myocardial infarction undergoing thrombolytic therapy. [8]

However, more recent studies have shown that the frequency of these disorders is lower after primary angioplasty, although the

latter ensures better permeability; these disorders mainly reflect myocardial ischemia related to a delay in flow in the microcirculation, and extensive suffering of the myocardium. [9] [10].

According to another study, AIVR is the most frequent arrhythmia occurring during primary angioplasty in patients with acute coronary syndrome with ST elevation, but not a marker of successful reperfusion. [7]

In our study, AIVR occur more frequently in patients undergoing thrombolytic drugs, (94.8 % vs 85.44 %, p= 0.026), but no significant association with the signs that reflect reperfusion such as resolution of chest pain, decrease of the elevated ST segment, and coronary flow restoration checked by coronary angiography.

There is no significant difference between the frequencies of persistence of chest pain in the groups of patients with or without accelerated idioventricular rhythm after thrombolysis (5.47 % (4 patients) versus 5.99 % (19 patients) respectively, p = 0.979); also for the frequencies of persistence of ST segment elevation after thrombolysis (4.10 % (3 patients) versus 6.94 % (22 patients) respectively, p = 0.476).

The frequency of occluded coronary artery (TIMI 0) is low in group of patient with accelerated idioventricular rhythm 14.51 % (9 patients) compared to group of patients without this rhythm 21.39 % (52 patients), but the difference isn't significant (p= 0.227).

So AIVR doesn't reflect coronary artery patency in patients undergoing thrombolytic drugs.

Conclusion

Accelerated idioventricular rhythm is common in acute coronary syndrome with elevated ST segment and generally considered as a sign of reperfusion; in our study, this rhythm may occur even in the absence of reperfusion of the occluded coronary artery and does not necessarily mean reperfusion or success of thrombolysis.

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