Molecular Crystals and Liquid Crystals

ISSN: 1542-1406 (Print) 1563-5287 (Online) Journal homepage: http://www.tandfonline.com/loi/gmcl20

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To cite this article: Diana Tint, Stefania Sima, Ileana Rau, Florin Ovidiu Ortan & Marius Alexandru Moga (2014) Advanced Metallic Stents and Their Efficiency in Complicated Myocardial Infarction Treatment, Molecular Crystals and Liquid Crystals, 603:1, 99-104, DOI: 10.1080/15421406.2014.968072

To link to this article: http://dx.doi.org/10.1080/15421406.2014.968072

Mol. Cryst. Liq. Cryst., Vol. 603: pp. 99–104, 2014

ISSN: 1542-1406 print/1563-5287 online
DOI: 10.1080/15421406.2014.968072

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Advanced Metallic Stents and Their Efficiency in Complicated Myocardial Infarction Treatment

DIANA TINT,[1,2,*] STEFANIA SIMA,[1] ILEANA RAU,[3] FLORIN OVIDIU ORTAN,[2] AND MARIUS ALEXANDRU MOGA[1]

[1]Faculty of Medicine, "Transilvania" University Brasov, Romania
[2]ICCO Clinics, Brasov, Romania
[3]Faculty of Applied Chemistry and Materials Science, University POLITEHNICA of Bucharest, Romania

Complete atrio-ventricular block (CAVB) develops in more than 5% of patients with myocardial infarction. Before the primary percutaneous coronary intervention (PCI) era, this condition was associated with poorer outcomes compared to those without complete AVB. Limited data are available regarding the outcome of these patients after primary PCI. In order to assess the outcome of patients with acute ST segment elevation myocardial infarction (STEMI) complicated with CAVB and treated with primary PCI a retrospective analysis of recordings of patients (pts) hospitalized with acute STEMI between 5.02.2009-30.05.2013 and treated with primary PCI was performed. The pts were divided in two subgroups: CAVB group and non-CAVB group, according to the presence or absence of CAVB at the time of PCI. Among 868 pts 57 pts. (6.5%) presented CAVB. The patients with CAVB were older (mean age 68.0 + 16.63 vs. 65.4 + 11.36 years, $p < 0.0000001$, were female in greater proportion (31.5% vs. 16%, $p = 0.043$), had more diabetes mellitus (28% vs. 15.6%, $p = 0.0148$) and had significantly higher mortality (14% vs. 2.4%, $p < 0.00001$) than patients without CAVB. The mortality was even higher in patients with CAVB and anterior infarction (43%). The resolution of CAVB after revascularization appeared in 76% of pts with inferior myocardial infarction and in just 28% of pts with anterior myocardial infarction ($p = 0.019$). In conclusion complete atrio-ventricular block in patients with acute myocardial infarction remains a severe condition associated with high in-hospital mortality despite prompt and efficient revascularization.

Keywords Metallic stents; complete atrio-ventricular block; myocardial infarction; primary PCI

Introduction

The treatment of acute myocardial infarction was a continuous evolving field. One important complication associated with acute myocardial infarction is complete atrio-ventricular block (CAVB) which was associated with worse prognosis. The patient in whom myocardial infarction is complicated with CAVB have poorer outcomes and higher mortality as compared to those without complete AVB [1, 2].

*Address correspondence to Diana Tint, MD, PhD, FESC Ass. Prof. at Faculty of Medicine, "Transilvania" University Brasov, 56 Nicolae Balcescu street, 500019 Brasov, Romania. Tel.: +(40) 744750630; Fax: +(40) 268 401203. E-mail: dianatint@gmail.com

Complete atrio-ventricular block develops in more than 5% of patients with myocardial infarction and the incidence of CAVB complicating myocardial infarction remained cvasi unchanged from the pre-thrombolythic era until today [3].

Revascularization therapies were expected to improve the prognostic and to decrease mortality of these patients. Indeed, data coming from thrombolytic era, demonstrated a slightly improvement prognosis in patients with myocardial infarction and CAVB, especially in those patients with inferior MI.

Percutaneous transluminal coronary angioplasty (PTCA) is a procedure performed to open clogged heart arteries caused by coronary artery disease and to restore arterial blood flow to the heart tissue without open-heart surgery. A stent is a tiny, expandable metal coil that is inserted into the newly-opened area of the artery to help keep the artery from narrowing or closing again. Newer stents (drug-eluting stents or DES) are coated with medication to prevent the formation of scar tissue inside the stent. These drug-eluting stents release medication within the blood vessel itself.

Coronary stents improved procedural safety and efficacy and eliminated the need for surgical standby. However, stent-mediated arterial injury elicited neointimal hyperplasia, leading to restenosis and the need for repeat revascularization in up to one third of patients.

Drug-eluting stents with controlled local release of antiproliferative agents have consistently reduced the risk of repeat revascularization, as compared with bare-metal stents [4].

The introduction of the DES proved to be an important step forward in reducing rates of restenosis and target lesion revascularization after PTCA. However, a new problem appeared: DES in stent restenosis which occurs in 3–20% of patients, depending on patient and lesion characteristics and DES type [5].

In this setting, dual antiplatelet therapy remains the cornerstone of medical therapy after PCI.

However, despite these advanced revascularization technologies, patients with anterior MI, remained at high risk of mortality and some required pacemaker implantation. With the increasingly widespread availability of mechanical reperfusion for MI, the prognosis of these high-risk patients would be expected to further improve, although limited data have been available to date [6–8)].

The aim of this study was to assess the in-hospital outcome of patients with acute ST segment elevation myocardial infarction (STEMI) complicated with CAVB and treated with primary percutaneous intervention (pPCI).

The method used in this study consisted in a retrospective analysis of 868 files of patients hospitalized with acute ST segment elevation myocardial infarction (STEMI). The patients were admitted in our clinic between February 5th 2009 and December 31th 2013 and treated with pPCI according to guidelines.

STEMI was defined as ST segment elevation >1 mm in two or more contiguous limb leads or ST-segment elevation >2 mm in two or more contiguous precordial leads, in association with chest pain lasting >30 minute. All STEMI were confirmed by demonstrating an elevated level of creatinine-kinase, creatinine- kinase MB and/or troponin.

After the ECG recordings analysis, we divided the patients in two groups: group A–patients with STEMI complicated with CAVB and group B–patients with STEMI without AVB. We intended to find out whether prompt mechanical revascularization has had an influence on resolution of CAVB and on the outcome of these patients.

From statistics point of view all demographic and clinical characteristics were compared for patients with and without CAVB using chi square test or Fisher's exact test.

Table 1. Baseline characteristics of patients with and without complete atrioventricular block

Characteristic	Group A	Group B	p
Mean age (years)	65.72 + 11.97	56.52 + 13.18	<0.0000001
Female	18 (31.57%)	135 (17%)	0.0043
History of hypertension	24 (42.1%)	400 (40.98%)	0.36
Smoking	21 (36.8%)	332 (40.98%)	0.53
Diabetes mellitus	16 (28.07%)	127 (15.67%)	0.014
Mean LVEF (%)			
Mean Na	138 + 5.42	137.41 + 3.96	0.285
Mean K	4.08 + 0.71	4.42 + 5.31	0.64
Glucose	148.67 + 64.99	190.44 + 94.64	0.06
Inferior MI	50 (87.71%)	390 (48.14%)	<0.0000001
Killip class III and IV	2 (3.5%)	18 (2.2%)	0.07
Ventricular fibrillation	5 (8.7%)	50 (6.1%)	0.43

A multivariate logistic regression model was fitted to evaluate the association between baseline demographic and clinical characteristics and CAVB. Two-sided P values of <0.05 were considered statistically significant. All analysis were performed using SPSS software (version 13.0, SPSS Inc., Chicago, IL, USA).

Results

The Incidence of the CAVB

From the whole studied group, we have identified 57 pts (6.56%) in whom myocardial infarction was complicated with CAVB. These patients were included in group A. The baseline characteristics of patients from the two groups were depicted in Table 1.

The patients with STEMI complicated with CAVB were significantly older (mean age 65.72 ± 11.97 vs. 56.52 ± 13.18 years; $p < 0.0000001$), were woman in higher proportion (31.57% vs. 17%; $p = 0.0043$) and have had diabetes mellitus in greater proportion that patients with STEMI without CAVB (28.07% vs. 15.67%; $p = 0.014$). There were no other

Table 2. Characteristics of patients with CAVB and anterior STEMI vs CAVB and non-anterior STEMI

Characteristic	Anterior STEMI	Non-anterior STEMI	p
Mean age (years)	68 + 16.63	65.4 + 11.36	0.59
Female	3 (42.8%)	15 (30%)	0.49
LVEF (%)	35	50.65	0.002612
Na (mmol/l)	140.83 + 3.4	137.77 + 5.55	0.24
K (mmol/l)	4.14 + 0.58	4.08 + 0.72	0.864

significant differences between the two groups in respect of other cardiovascular risk factors (smoking, hypertension, dyslipidemia).

As expected, CAVB occurred in higher proportion in patients with inferior myocardial infarction than in patients with anterior infarction (87.71% vs. 48.14%; $p < 0.0000001$).

Baseline Characteristics

Clinical characteristics of patients with and without CAVB were depicted in Table 1.

Analyzing the characteristics of patients with CAVB according to the localization of myocardial infarction, we found out that the patients with anterior myocardial infarction were slightly older (although the difference was not statistically significant) and had more severe damage of myocardium, reflected in significantly lower left ventricular ejection fraction (LVEF) (35% vs. 50.65%, $p = 0.0026$). The difference persisted despite the prompt mechanical revascularization by pPCI.

All patients received at least one stent, bare metal stents (240 patients, 27.2%) or drug eluting stents (627 patients, 72.8%) (Table 2). There were no differences in respect of type and number of stents delivered in patients with and without CAVB.

The outcome was unfavorable in patients with CAVB as compared with patients without CAVB. In-hospital death was significantly higher in CAVB group than in non-CAVB group (14% vs. 2.4%, $p < 0.00001$). Of note, mortality was very high in patients with CAVB and anterior infarction (42.85%) and significantly higher as compared with patients with CAVB and inferior infarction (10%, $p = 0.0189$). The resolution of CAVB after revascularization appeared in 76% of patients with inferior myocardial infarction and in only 28% of patients with anterior myocardial infarction ($p = 0.0072$).

Discussion

The incidence of CAVB appeared to be lower than in thrombolytic era, according to recent published results of a Danish study in which the included patients were identified through a hospital register and the Danish National Patient Register and were treated with pPCI. High-degree atrioventricular block was documented in 67 patients (3.2%) and 56 of them (83.5%) have had CAVB [9].

In our study, CAVB mostly occurred in patients with non-anterior (inferior, infero-posterior) myocardial infarction. The more frequent occurrence of CAVB in this setting is usually explained by the fact that the blood supply to the AV node depends in 90% of patients on the right coronary artery. Other collateral supply of NAV is provided by the septal branch of left anterior descending artery (LAD) and, in some cases, when culprit lesion involves proximal segment of LAD and occlusion is followed by an extensive myocardial damage, CAVB occurs as a consequence of extensive LV necrosis. This is the situation of CAVB complicating an anterior myocardial infarction [10, 11].

In 2009, Hreybe also reported the fact that patients with inferior or posterior AMI were more likely to develop complete heart block compared to those with anterior or lateral AMI (3.7% vs 1.0%, hazard ratio [HR] = 3.9, $p < 0.001$), but less likely to die prior to hospital discharge (7.7% vs 11.3%, HR = 0.65, $p < 0.001$) [12].

In our study, patients with CAVB and anterior myocardial infarction have had a very high in-hospital mortality (42.85%). Our data are in agreement with literature data that demonstrated increased mortality in that category of patients [2, 13].

Higher mortality in patients with CAVB and anterior AMI versus CAVB and inferior AMI could be explained by the physiopathology of CAVB discussed above and could

probably be the consequence of greater infarct size. Thus, many studies have shown that even patients with inferior MI associated with high degree AV block have larger infarctions [14, 15].

Regarding the predictive markers of CAVB occurrence, our study found older age, female sex and diabetes mellitus. These results are in concordance with data published in literature [1, 9].

Thrombolythic therapy has been demonstrated to improve the prognosis of such patients, especially those with inferior MI [1–3, 6–8]. However, data are sparse in respect with effect of pPCI.

A report published in 2011, on a series of CAVB in patients with anterior AMI, suggests that complete AVB complicating anterior MI is reversible with acute PTCA and survivors are not at increased risk of recurrent AVB. Nevertheless, this condition remained associated with extensive myocardial damage and high mortality during the acute hospitalization which was not significantly improved with correction of AVB with temporary pacing [16].

The same result was resulted from our study in which we found a significantly higher mortality in patients with CAVB as compared with patients with non CAVB, thus, pPCI did not add a significant benefit with respect of in-hospital survival. This is especially true in patients with CAVB and anterior myocardial infarction.

Another recent study showed however a remarkable relative reduction (40–60%) of the incidence of high-degree AVB in STEMI patients treated with pPCI compared with reports of thrombolytic era. The incidence of high-degree AVB beyond the first two days after the pPCI was reduced with 10% in absolute numbers. Despite that however, high-degree AVB remains a sever prognostic marker in the PCI era with high mortality rates in first 30-days [9].

Conclusions

The main conclusions of our study are:

- In our study CAVB persisted in 70% of patients with anterior AMI and 43% died in the first 24 hours after pPCI despite the temporary cardiac stimulation.
- In patients with CAVB and inferior AMI, the reversibility of the CAVB was higher (72%) and the mortality was lower (10%).
- The patient's outcome was not influenced by type of stent implanted (bare-metal or drug-eluting stent.
- The results of our retrospective study showed that complete atrio-ventricular block in patients with acute myocardial infarction remains a severe condition associated with high in-hospital mortality despite prompt and efficient revascularization.

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