Myocardial infarction with complete right bundle branch block: clinical and evolutionary profile

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Summary

Background : Complete right bundle branch block is known to be an independent predictor of all-cause mortality. Myocardial infarction with complete right bundle branch block is an entity that still poses many diagnostic and therapeutic problems. The problem is how to ensure adequate management of patients with this entity. The aim of our work was to study the short and medium-term clinical and evolutionary profile in this entity.

Methods: Retrospective descriptive study including patients admitted for myocardial infarction. We excluded patients with any other permanent conductive fault other than right bundle branch block. These patients were divided into groups according to the presence or absence of complete right bundle branch bloc. They were compared clinically, electrically and sonographically over time in order to identify prognostic factors.

Results: Of our 315 myocardial infarction patients, 53 had complete right bundle branch block (group 1) and 262 had fine QRS (group 2). the majority of patients in group 1 were elderly. This group also had a higher number of pack-years, diabetes, renal insufficiency and respiratory pathologies. Signs of left heart failure were more frequent in group 1 ($p<0.001$), as was cardiogenic shock ($p=0.009$). Supraventricular and ventricular rhythm disorders were also more common in this group ($p=0.025$ and $p=0.01$ respectively). A left ventricular systolic ejection fraction < 40% was significantly more common in group 1 ($p=0.007$), as was damage to the anterior interventricular artery ($p=0.005$), while damage to the right coronary artery was more common in group 2 ($p=0.013$). Finally, the development of contrast nephropathy, heart failure, rhythm disorders and short- and medium-term death was significantly more frequent in group 1.

Conclusion: Complete right bundle branch block associated with myocardial infarction is a poor prognostic sign. Rapid revascularization is essential to stop myocardial damage leading to serious rhythm disorders and heart failure.

Keywords

Myocardial infarction, Right bundle branch block, Heart failure, Coronary angiography, Revascularization, Mortality.

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INTRODUCTION

The right branch of the HIS bundle receives a double blood supply, essentially via the left anterior descending coronary artery (LAD) and secondarily via the left circumflex artery (Cx) or the right coronary artery (RCD), depending on the dominance of the coronary network.

Complete right bundle branch block (RBBB) is an independent predictor of all-cause mortality and is associated with a multitude of aetiologies, including ischaemic heart disease, which is the leading cause of death worldwide [1,2].

The prevalence of the association of myocardial infarction (MI) and RBBB varies between 3% and 29% according to studies conducted in the pre-thrombolytic era [3–8]. This vast difference is explained by the different criteria used to select patients and define RBBB.

While MI with complete left bundle branch block (LBBB) has been an indisputable indication for emergency coronary angiography since the European Society of Cardiology (ESC) guidelines in 2012 [9], MI with RBBB is an entity that still poses many diagnostic and therapeutic problems.

he electrocardiogram (ECG) is the primary tool for making the diagnosis of MI in emergency departments, with interpretation even more difficult in the presence of a RBBB. An untrained clinician may be misled by such an ECG in the absence of well-established criteria suggestive of progressive infarction, as in the case of MI and LBBB (Sgarbossa criterion and Cabrera sign), and subsequently delay appropriate management, including urgent invasive exploration, which may make the patient's prognosis worse.

Several studies have shown that the association of RBBB and MI is associated with a greater area of myocardial necrosis, heart failure, threatening arrhythmia, the need for pacing and death within the hospital and in the medium term [10–13]. The current trend therefore seems to favour an urgent invasive strategy in the presence of RBBB.

Few studies in Tunisia have focused on this entity, particularly in terms of mortality.

Thus, the problem consists in defining an adequate management of these patients in order to improve their prognosis.

It is within this framework that our work was carried out with the aim of :

- Study the clinical, electrical, echocardiographic and angiographic profile of patients with MI and RBBB.

- To study the intra-hospital and medium-term evolutionary profile of these patients compared with patients admitted for MI without bundle branch block.

MATERIALS AND METHODS

Study population

Our study was a retrospective descriptive trial. We investigated patients who presented with confirmed MI from January 1, 2019 to June 31, 2021.

Inclusion criteria

- Patients admitted to the cardiology department for confirmed type 1 MI.

- Patients who underwent coronary angiography with lesions explaining the myocardial damage.

Exclusion criteria

Patients who met any of the following criteria were then excluded from the study:

- Patients with stimulo-dependent pacemakers.

- Patients with LBBB or undetermined intraventricular block.

- Patients with known RBBB.

- Patients with incomplete right bundle branch block.

- Patients who have not undergone coronary angiography.

- Patients with COVID-19 confirmed by a rapid test or PCR.

- Patients with incomplete follow-up.

Data collection

For each patient we collected:

- Demographic data and history.

- Clinical, electrocardiographic, echographic and coronary data on admission.

- Medications, methods and time of revascularisation

- In-hospital follow-up.

- clinical, electrocardiographic and echographic follow-up at one year.

Definitions

Type 1 myocardial infarction:

Type 1 MI is defined according to the fourth universal definition of myocardial infarction 2018 [14].

Right bundle branch block

CRBBB is defined according to the ACC/AHA recommendations for the interpretation of the electrocardiogram [15].

Heart failure

Chronic heart failure is defined according to the ESC 2021 guidelines [16].

Major adverse cardiovascular and cerebrovascular events (MACCE)

MACCE are defined by the occurrence of re-infarction, re-hospitalization for heart failure, stroke and high-grade atrio-ventricular block (AVB) [17].

Follow up and endpoints

• The primary end point:

All-cause mortality at one year.

• The secondary end point:

Occurrence of major adverse cardiac and cerebrovascular events (MACE) including : re-hospitalisation for heart failure, re-infarction, high-grade AVB and all-cause mortality.

Statistical analyses

The data were entered and analysed using SPSS version 26 software.

Descriptive study

- Qualitative variables were described using observed numbers and frequencies (%).

- For quantitative variables, data distribution was studied using skewness and kurtosis coefficients and normality tests. These variables were described by means and standard deviation in the case of a normal distribution, and by medians and interquartile ranges in the opposite case.

Analytical study

- For the analysis of the association between two qualitative variables, we used Pearson's chi2 test for the comparison of two frequencies if the conditions of application were verified and Fischer's test otherwise.

- To analyse the association between a qualitative and a quantitative variable, we used the Student's t test to compare two means and the non-parametric Mann Whitney test otherwise.

- Univariate and multivariate analysis was used to identify factors predictive of mortality.

- The significance threshold was set at p ≤5%.

RESULTS

During the study period, a total of 430 patients with MI presented to the emergency department at Mongi Slim Hospital. However, 115 patients were excluded from the study for various reasons. (Figure 1).

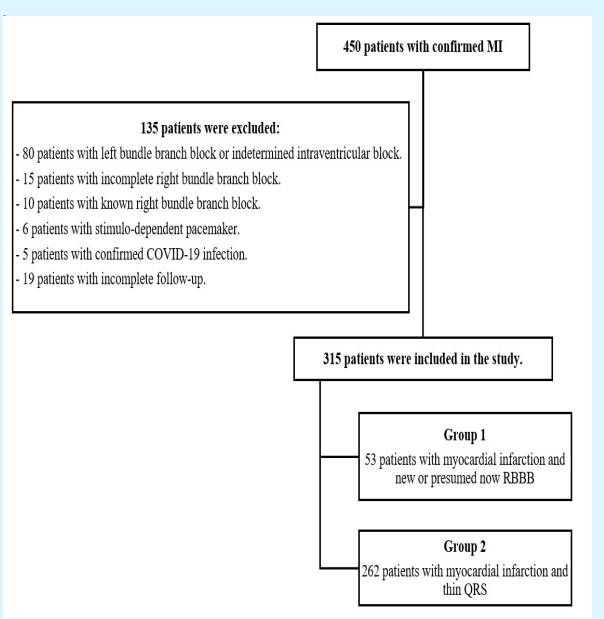

Figure 1. Flowchart illustrating the distribution of the total population.

A total of 315 patients admitted for MI were finally included in our study : 53 patients with complete right bundle branch block (Group 1), and 262 patients with thin QRS (Group 2).

Descriptive study of the myocardial infarction group with complete right bundle branch block

Baseline characteristics

In our real-life study, a clear male predominance was observed (81%) with a sex ratio of 4.3. The average age of the first group was 65.25±10.25 years. The proportion of elderly patients (65 years) was 49.1%. A high prevalence of hypertension was noted in our series (54,7 %), and diabetes was present in 69,8 % of

the patients. Chronic renal insufficiency was identified in fourteen patients (26.4%) (Table 1). The cardiovascular risk factors and comorbidities are resumed in Table 1.

Table 1. Cardiovascular risk factors and comorbidities of Group I

Risk factors	Number	Percentage
Diabetes	37	69,8 %
Arterial hypertension	29	54,7 %
Dyslipidemia	5	9,4 %
Chronic renal failure	14	26,4 %
Active Smoker	27	50,9 %
Ischemic stroke	4	7,5 %
COPD	7	13,2 %
Hypothyroidism	1	1,9 %
AF	2	3,8 %

AF : Atrial fibrillation, COPD : Chronic obstructive pulmonary disease

Clinical, electrical and echocardiographics

Most patients admitted for MI with RBBB, i.e. 38 (71.7%) patients, were admitted in the context of STEMI compared with 15 (28.3%) admitted for NSTEMI. Of the patients admitted for STEMI, 17 (44.73% of STEMI) consulted emergency departments late (>12 hours). The mean time from the onset of thoracic pain to STEMI patient consultation was 11,5 hours, with a range from 1 to 336 hours. Signs of left ventricular failure (LVF) (≥ Killip II) on admission were present in 29 patients, i.e. 54.7%, with a predominance of class II of the KILLIP classification. Cardiogenic shock was present in 7 patients (Table 2).

Table 12. Distribution of patients according to the KILLIP classification

Risk factors	Number	Percentage
Killip I	24	45,3 %
Killip II	20	37,7 %
Killip III	2	3,8 %
Killip IV (Cardiogenic shock)	7	13,2 %

Electrically, seven patients (13.2%) were in atrial fibrillation. The RBBB was permanent in 83% of cases (n=44) and transient in 17% (n=9). The left anterior hemi-block (LAGH) was present in 20 patients (37.7%) while the left posterior hemi-block (LPHB) was present in 13 patients (24.5%). A qR aspect of the QRS was observed in 52.8% of cases (n=28), RR' in 20.8% of cases (n=11) and rsR' in 26.4% of cases (n=14). The Q wave of necrosis was present in 33 patients (62.3%). QRS duration ranged from 120 to 180 ms with a mean of 143 ± 15 ms. Most STEMI patients had an anterior ST-segment elevation (71.1%).

Sonographically, the mean LVEF was 42 ± 16%. Half of the patients, i.e. 26 patients (49%), had a reduced LVEF (LVEF< 40%). Left ventricular filling pressures (LVFP) were elevated in 22 patients (44.2%).

Angiographic findings and reperfusion strategies

The median time to coronary angiography for STEMI was 17 hours, with extremes ranging from 4 to 432 hours. In our study, we opted for primary angioplasty (24 patients, i.e. 63.15%) rather than thrombolysis, which was performed in 9 cases with 4 failures (10,52%) requiring salvage angioplasty. Almost half of the patients had monotruncular status (45.3%). A bi-truncular status was observed in 28,3 % and a tri-truncular status in 26,4 %. In most cases, the culprit artery was the left anterior descending artery (LAD) (71,7%), especially the middle segment, which was the most affected.

Comparative study

In-hospital treatment and progress

The median hospital stay was longer in group I (8 days vs 7 days) with no significant difference(P=0,93). The thrombolysis failure rate was higher in the 1st group (44.4% vs. 27%), with no significant difference (p=0,821). We had significantly more recourse to vasoactive drugs in the 1st group (30.2% vs 7.3%; p<0.001), as did the use of anti-SGLT2 (17% vs 0.8%; p<0.001), diuretics (39.6% vs 19.1%; p=0.001).

Contrast nephropathy, renal failure, severe ventricular rhythm disorders, high-grade AVB, heart failure, infections and cardiorespiratory arrest were significantly more common in the 1st group.

Medium-term follow-up (one year)

Re-hospitalisation for heart failure was significantly higher in the 1st group (23.8% vs. 8.5%; p=0.006), as was worsening of renal function (14.3% vs. 2.3%; p=0.002).

From an electrical point of view, ventricular arrhythmia was more frequent in the 1st group (2.4% vs. 0.8%), with no significant difference. High AVB degrees were significantly more frequent in the 1st group (16.7% vs 0.4%; p<0.001).

No patient underwent cardiac resynchronization.

Prognostic factors

Mortality was significantly higher in the group of MI patients with RBBB (16,7% vs 4,6% ; p=0,009). Figure 2 shows the survival curve for the two groups.

The same goes for MACCE (45,2% vs 23,5%; p=0,003).

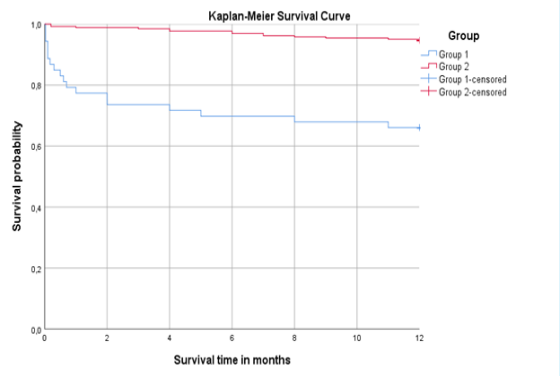

Figure 1. Kaplan-Meier survival curve for the two groups

Mortality was significantly associated with diabetes (p=0.03; OR=5.33; CI95%=1.05-26.89), the presence of renal failure (p<0.001; OR=16.76; CI95%= 3.68-76.34), impaired LVEF (p=0.001; OR=8.75; CI95%=2.31-33.13) and the presence of bifascicular block (p=0.004; OR=30.27; CI95%= 1.24-739.25)

All cases of cardiogenic shock were fatal (p<0.001).

The independent factors associated with mortality in the MI with RBBB population:

- Chronic renal failure
- Heart failure with impaired LVEF < 40%
- Bifascicular block
- Tritruncal coronary status

Table 3. Factors predictive of mortality

Factors	Univariate analysis	Multivariate analysis
Smoking	0,055	0,143
Diabetes	0,03	0,256
Hypertension	0,097	0,356
Chronic renal failure	<0,001	0,023
Cardiogenic shock	<0,001	-
Impaired LVEF	0,001	0,033
Tritruncal coronary status	0,191	0,041
STEMI	0,177	0,961
Bifascicular block	0,004	0,026

LVEF : Left ventricular ejection fraction ; STEMI : myocardial infarction with persistent ST segment elevation

DISCUSSION

In our study, a clear male predominance was observed, with 81.1% of patients being male, which is consistent with the study by Neumann et al. [18] in which 80% of 125 patients admitted for MI with RBBB were male. High testosterone levels in men were linked to an increased risk of cardiovascular disease[19].

Risk Calculator: SCORE2

The rate of chronic renal failure was high in the RBBB population at 26.4% and higher compared to thin QRS patients with a significant difference (p=0.003). This is consistent with the study of Kleemann and al. [23] where the prevalence of chronic renal failure is higher in the RBBB group (p<0,05.).

RBBB was present in 12.2% (n=15) of patients admitted for NSTEMI (n=123) and in 19.8% (n=38) of patients admitted for STEMI (n=192). These percentages are higher than those found in the literature[21,23].

A delay in consultation exceeding 12 hours for STEMI was more marked in the group of MI with RBBB compared with the group of MI with thin QRS, without a significant difference (47.4% vs 36.4%; p=0.397). These differences, although not significant, may be related to the high prevalence of diabetes and advanced age in the RBBB MI population, making pain less suggestive of myocardial ischaemia, or even non-existent, and thus delaying consultation[24–26].

Signs of left ventricular failure (LVF) were present in more than half the population of MI with RBBB, with a predominance of KILLIP II class. Compared with thin QRS MI, the first group had a high prevalence of LVF signs (≥ Killip II) with a significant difference, which is consistent with the literature [10,27,28].

As shown in the literature, in our study the incidence of cardiogenic shock (CS) was higher in the RBBB group (13.2%) compared to the fine QRS group (3.4%) with a significant difference (p<0.009)[23,29–31].

Bifascicular block was observed in 62.3% of cases, a result in line with the literature. Moreno reported a 59% rate of bifascicular block in patients admitted for MI with first-discovered RBBB [10]. In the study by Widimsky et al, the prevalence of this type of block was 56% [32].

Most patients (71.7%) had systematic ST elevation on the admission ECG. Of these, 71.1% had an anterior ST elevation, which is in line with the literature (Table 4).

Table 4. Distribution of patients with MI and RBBB according to electrocardiographic territory of ST-segment elevation

Factors	Anterior ST elevation	Inferior ST elevation
Alan et al. [10]	78 %	-
Kleemann et al. [23]	56 %	-
Melgarejo Moreno et al. [30]	67,2 %	-
Wong et al. [33]	72,4 %	27,6 %
Our Study	71,1 %	23,7 %

LVEF was significantly lower in the 1st group (41.42% vs 47.98%; p=0.005), a result similar to that of the Moreno et al. study in which an average LVEF of 42% was observed in the RBBB group vs 47% in the fine QRS group with a p<0.05[10].

The presentation of the LAD as the culprit artery was significantly higher in the 1st group (71.7% vs 50.8%; p=0.005). This can be explained by the fact that right bundle-branch runs in interventricular septum, and the blood supply is mostly provided by the first septal branch separated from LAD.Therefore, new-onset RBBB is likely caused by proximal occlusion of LAD[28,34]. These results and explanations were supported by several other randomized studies [31,32,35].

The median hospital stay was longer in group 1 (8 days vs 7 days) with no significant difference (P=0,93), as shown in in the studies of Guerrero et al. (7,1 vs 6,5; P=0,11) [36] ; and Figueroa-Triana et al. (6 in both groups; p=0,238) [21].

The increased use of vasoactive drugs in the 1st group (30.2% vs 7.3%; p<0.001), as did the use of diuretics (39.6% vs 19.1%; p=0.001) is explained by the increased incidence of LV dysfunction and shock seen in MI associated with RBBB, as confirmed by the studies of Widimsky et al., Guerrero et al et Iwasaki et al. [28,32,36]

In this study, there was a significantly higher rate of heart failure, cardiogenic shock, malignant rhythm disorder and high AVB degree in the group of MI with RBBB.These serious complications expose patients in this entity to a higher risk of in-hospital and medium-term death, as was observed in our study. These findings are in line with several studies[37–40].

Finally, no patient benefited from cardiac resynchronization, which can be of great help in these patients whose main complication is heart failure, and even in the literature there is a lack of studies examining the contribution of resynchronization in ischaemic heart failure associated with RBBB.This option should be the subject of several studies in the future to try to improve the prognosis of these patients.

CONCLUSION

Myocardial infarction associated with the presence of complete right bundle branch block appears to be an entity with a poor prognosis, probably related to the necrosis of a large myocardial mass and the development of left ventricular failure. Our study argues in favour of urgent coronary angiography at the slightest suspicion of myocardial infarction associated with the presence of complete right bundle-branch block in order to save the myocardium. Further trials would appear to be useful to study cardiac resynchronisation therapy in this entity.

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