

## RESEARCH PAPER

# Angiographic findings in patients with conduction defect on resting electrocardiography

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## ABSTRACT

**Background:** Conduction defect is one of the causes for increase morbidity and mortality among cardiac patients and a predictor of poor prognosis that affect survival and increase mortality rate.

**Objectives:** To study the relationship between angiographic severity and extent of coronary artery in patients with coronary artery disease and conduction defect on resting electrocardiography.

**Patients and methods:** A total of 127 patients participated in this study, (83) males and (44) females of mean age ( $60.7 \pm 10.5$  years) presented with chest pain (74%) or shortness of breath (26%) admitted to the coronary care unit at Alsader -teaching hospital and cardiac center at Basrah oil hospital between the period from February 2019-october 2020. Medical history was recorded for comorbidities and cardiovascular risk factors. Electrocardiography was taken for each patient at rest and categorized into LBBB, RBBB, AV Block according to standard ECG criteria. Echocardiography was performed for each patient to assess LV function. All the patients underwent coronary angiography and assessed visually by at least two cardiologists and evaluated using Gensini score calculated for each patient to assess extent and severity of CAD.

**Results:** Patients with conduction defect have a high Gensini score which indicates severe CAD in RBBB more than LBBB patients and significantly higher in three vessels disease, this study showed more extensive CAD and significant correlation among patients with diabetes and hypertension, on other hand; Gensini score was not related to the echocardiographic finding of LV systolic dysfunction.

**Conclusion:** Conduction defect correlates with severe CAD as assessed by coronary angiography especially among hypertensive and diabetic patients.

**Key words:** Conduction defects, Angiographic severity, coronary artery disease

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## Introduction

Conduction defect is classified into the atrioventricular defect (AV block) due to a defect in the vagal tone, SA node, AV node.<sup>1</sup> which is an either high degree (2<sup>nd</sup> and 3<sup>rd</sup>-degree

heart block) symptomatic and usually need intervention due to high risk of short-term mortality rate which commonly complicates the myocardial infarction,<sup>2</sup> or 1<sup>st</sup> degree heart block which is considered as a benign block and asymptomatic in a healthy person with no cardiovascular risk. But it is reported that 1<sup>st</sup>-degree heart block increases risk of atrial fibrillation and it is also associated with heart failure (HF) and cardiovascular mortality.<sup>3</sup>

interventricular block including both LBBB, RBBB. Patients with BBB are at an increasing risk of mortality rate and decrease lifelong survival with poor outcome especially with RBBB.<sup>4</sup> This might be correlated to the RV dysfunction or due to desynchronized ventricles.<sup>5,6</sup> Conduction system consists of S.A node, A.V node, Bundle of His and Bundle branches. S.A node is located at Rt atrium laterally in the right atrial sulcus terminals at the junction of superior vena cava and Rt atrium supplied 55%-60% from RCA, 40%-45% from circumflex coronary artery.<sup>7</sup> A.V node tract nodal tissue, located within the triangle of Koch, is divided into two major components: inferior nodal extension and penetrating bundle. Inferior nodal extension is located between the coronary sinus and tricuspid valve. It is continuous with penetrating bundle which emerges in the ventricle as a bundle of His.<sup>8</sup> A.V node supplied in 85%-90% from a branch RCA. A branch of LCX provides the remainder population. It is supplied by posterior descending branch which determines the dominant blood vessel.<sup>7</sup> Bundle of His, it is a continuation of the penetrating bundle on the ventricular side of AV junction then divided into LT, RT bundles, branched from anterior and posterior descending coronary artery supply upper muscular interventricular septum which makes conduction system at the site more impervious to ischemic damage unless ischemia is extensive. RBB receives blood supply from the septal perforator, a branch of Lt anterior descending artery, LBB supplied by both Lt anterior descending artery and Rt coronary artery.<sup>8</sup> Atrioventricular block can be permanent or transient depending on functional and anatomical impairment. It mostly occurs between the SA node and atrium, between the atrium and ventricles.<sup>7</sup> The atrioventricular block usually complicates myocardial infarction either due to

the large size of infarction or due to right ventricular infarction, AV node, or due to bezold-jarisch reflex.<sup>9</sup> It is more common to occur in anterior wall infarction<sup>10</sup> due to extensively necrotic septum.<sup>11</sup> Coronary Angiography is the gold standard test to assess the extent of coronary atherosclerosis. One of the most widely used scoring systems developed by Gensini<sup>12,13</sup> used for assessment of coronary angiographic results,<sup>14</sup> the severity of stenosis indicated by decrease luminal diameter. Zero score indicate no stenosis in the lumen of the coronary tree. It collects the score taking into consideration the degree and location of the luminal narrowing and the effect of multiple obstructions. Gensini score is a sum of lesion scores that provide a quantitative variable used in the statistical analysis.<sup>30</sup>

The aim of the study is to analyze the CAD angiographically including the extent and severity of CVD among patients with conduction defect on resting electrocardiography.

## Materials and Methods

This is across sectional observational study that was conducted in Basrah cardiac center at AlSader teaching hospital between February 2019 - October 2020. A total of (127) patients: (83) males and (44) females undergo the study after taking complete authorization from the patients and their relatives with their telephone number for follow up for their number of hospitalization in the last year and death. The study was done in Basrah cardiac center on patients found to have a conductive defect on resting electrocardiography with the calculation of QRS duration and p-r interval and studying the extent and severity of CAD by coronary angiography using Gensini score. Inclusion criteria includes all patients with conduction defect on resting ECG. A total of (79) patients are

considered as complete LBBB if they met the electrocardiographic criteria of [7]: QRS duration more or equal to 120 msec. notched, Broad R waves in lateral leads (V5 and V6) and leads I and a VL. Small or absent initial r waves in right leads (V1 and V2) followed by deep S waves. Absent septal q waves in left-sided (I, V5, V6) leads. prolong time R wave to peak in lateral lead > 60msec. A total of (40) patients are considered as RBBB after meeting the electrocardiographic criteria of [7]: duration of QRS more or equal to 120 msec. An rsr', rSR', rsR' in V1, V2 pericardial leads. An S wave more or equal to 40msec wide in pericardial leads I, V6. An R peak time of more than 50msec in lead V1 but normal in pericardial leads V5 and V6. And (8) patients were considered to have atrioventricular block if they met the criteria of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>-degree heart block. Using Minnesota Code Criteria, 19 physicians classified the AV conduction as normal, first-degree AV block (P–R interval  $\geq$  0.22, recorded as a dichotomous variable), Mobitz I block, Mobitz II block, third-degree block complete AV dissociation.<sup>7</sup> Exclusion criteria includes Wolf–Parkinson White (WPW) syndrome. Ventricular pacing. Idiopathic ventricular rhythm. Left ventricular outflow obstruction. Aortic stenosis. Hypertrophic cardiomyopathy. Ventricular arrhythmias. History of coronary artery bypass grafting. End-stage renal disease. Severe decompensated cardiac failure. And Patients with an allergic reaction to contrast media.

### Statistical analysis

Collected data were fed into SPSS version 25 for tabulation and analysis. Categorical variables were presented as frequency and percentages while numeric variables were shown as mean and SD. Tests of normality were performed to select suitable statistical procedures. Non-parametric

statistical tests namely Mann Whitney and Kruskal Wallis tests were used to compare continuous variables. Spearman's correlation coefficient was used to study correlation between those variables. The level of significance was set to be 0.05.

### Results

One hundred twenty-seven patients underwent coronary angiography, male 65.4% with mean age  $60.06 \pm 10.68$  years and female 34.6% with mean age  $62.13 \pm 10.18$ . One third smokers 30.7%, non-smoker 60.6% and x-smoker 8.7% and 59% were found to have diabetes, hypertension 73.2% and impaired renal function with GFR < 60(4.2%). (Table-1)

**Table 1.** patient's characteristics in the study sample.

| Risk factor | Male No. (%) | Female No. (%) | Total       |
|-------------|--------------|----------------|-------------|
| Smoker      | 38 (45.8)    | 1(2.3)         | 39 (30.7)   |
| Non-smoker  | 34(41.0)     | 43(97.7)       | 77 (60.6)   |
| x-smoker    | 11(13.2)     | 0(0.0)         | 11 (8.7)    |
| DM          | 56(76.5)     | 19(43.2)       | 75 (59.1)   |
| HTN         | 57(68.7)     | 36(81.8)       | 93 (73.2)   |
| eGFR<60     | 10(12.0)     | 8(18.2)        | 18 (14.2)   |
| Normal BMI  | 24(28.9)     | 12(27.3)       | 36(28.3)    |
| Overweight  | 35(42.2)     | 13(29.5)       | 48(37.8)    |
| Obese       | 24(28.9)     | 19(34.2)       | 43 (33.9)   |
| Total       | 83(100.0)    | 44(100.0)      | 127 (100.0) |

They were presented with chest pain and shortness of breath and we found that patients present with ischemic chest pain (74%) more than the patients with shortness of breath (26%). On resting electrocardiography those presented with LBBB 62.2%, 59.5% males, 40.5% females while RBBB were 31.5%, 72.5% male and 27.5% female. Atrioventricular patients were eight patients, 87.5% males and 12.5% females. There is no significant relationship between types of

conduction defect among different sex or age. Also, there was no significant association between electrocardiographic findings of conduction defect and an impaired renal function test. There is an increased incidence of conduction defect on resting electrocardiography in patients who have hypertension that present with p-value = 0.02 and diabetes with p - value = 0.05, respectively.

**Table 2.** Gender and age relationship to electrocardiographic conduction defect findings.

| Variables     | LBBB<br>No.<br>% | RBBB<br>No.<br>% | AV<br>block<br>No. % | Total     | P-<br>value |
|---------------|------------------|------------------|----------------------|-----------|-------------|
| Male          | 47(59.5)         | 29(72.5)         | 7(87.5)              | 83(65.4)  | 0.1         |
| Female        | 32(40.5)         | 11(27.5)         | 1(12.5)              | 44(34.6)  |             |
| < 50<br>years | 10(12.7)         | 9(22.5)          | 0(0.0)               | 19(15.0)  | 0.1         |
| > 50 years    | 69(87.3)         | 31(77.5)         | 8(100.0)             | 108(85.0) |             |
| DM yes        | 41(51.9)         | 27(67.5)         | 7(87.5)              | 75(59.1)  | 0.05        |
| No.           | 38(48.1)         | 13(32.5)         | 1(12.5)              | 52(40.9)  |             |
| HTN yes       | 61(77.2)         | 24(60.0)         | 8(100.0)             | 93(73.2)  | 0.02        |
| No            | 18(22.8)         | 16(40.0)         | 0(0.0)               | 34(26.8)  |             |
| eGFR <<br>60  | 12(15.2)         | 6(15.0)          | 0(0.0)               | 18(14.2)  | 0.4         |
| eGFR ><br>60  | 67(84.8)         | 34(85.0)         | 8(100.0)             | 109(85.8) |             |

Regarding LV systolic function, the EF ranged from 10-77% with a mean of 46.0 and a SD of 13.6. Overt LV ventricular dysfunction was reported in 54.3% while 45.7% had normal EF counting in all the studied patients. Three vessel disease shows a high rate among patients with conduction defect and it is higher among LBBB but statistically not a significant relationship between types of conduction defect and the number of diseased vessels. Three-vessel disease had the highest incidence of conduction defect (37.0%) followed by two-vessel disease (27.6%)

and the least was single-vessel disease (19.7%). LAD was the most frequently affected artery (74%). RCA and LCX came after with rates of 52.8% and 43.3%, respectively. LMS was the least (18.9%). Twenty-one (16.5%) of patients displayed thrombus and in 14 (11%) of them, the thrombus was in the bifurcation. Gensini score was highly significant in males than in females (P value < 0 .005). However, and significant in diabetic patients (P-value = 0.001), other variables did not show a significant statistical difference in their corresponding levels of Gensini score (P values > 0.05). These variables include BMI, HT and renal impairment as well as smoking habits and age factors. Age did not seem to have different levels of Gensini score when categorized into two categories with reference of 50 years (P-value > 0.05). The mean of Gensini score was significantly higher in RBBB than LBBB (P value < 0.05). In AV block, Gensini score showed even higher level than both LBBB, RBBB but when performing post hos analysis, it revealed that the difference of AV block from both RBBB, LBBB was not statistically significant (p-value=0.117 and 0.697 respectively). LV systolic dysfunction did not show a significant difference in the level of Gensini score (p-value > 0.05).

**Table 3.** Relationship of Gensini score with electrocardiographic finding and vessels involved in studied patients.

| Variable               | No.      | Gensini Score |       | P<br>value |
|------------------------|----------|---------------|-------|------------|
|                        |          | Mean          | SD    |            |
| ECG finding            | LBBB     | 79            | 43.9  | 0.028*     |
|                        | RBBB     | 40            | 65.0  |            |
|                        | AV block | 8             | 72.3  |            |
| Fate after 1<br>year   | Survival | 121           | 50.4  | 0.041*     |
|                        | Death    | 6             | 92.5  |            |
| Thrombus               | 1        | 21            | 59.9  | 0.450*     |
|                        | 2        | 106           | 50.9  |            |
| Vessels<br>involved*** | 1        | 25            | 28.00 | 0.001**    |
|                        | 2        | 35            | 54.33 |            |
|                        | 3        | 47            | 84.37 |            |
| EF                     | Normal   | 58            | 44.5  | 0.103      |

\*Mann Whitney's test, \*\*Kruskal Wallis test

Death rate was associated with a significantly higher level of Gensini score than those who survived ( $P$  value  $< 0.05$ ). Gensini score was highest when three vessels were involved. It was less in two vessels and least in one vessel involvement. The observed differences were statistically significant ( $P$  value  $< 0.05$ ). Having a thrombus or the thrombus was located in the bifurcation did not seem to affect the levels of Gensini score ( $P$  values  $> 0.05$ ). No significant correlation was observed between Gensini score and number of admissions on the last year of follow up ( $R = 0.09$ ). The majority of patients reported fewer hospitalization. However, the number of hospitalization extended to 10 though in a minority of patients.

**Table 4. Correlation coefficient of Gensini score with age, EF and hospitalization.**

|               |         | Age | Gensini score | EF    | Hospitalization |
|---------------|---------|-----|---------------|-------|-----------------|
| Age           | R*      |     | 0.05          | -0.09 | 0.155           |
|               | P value |     | 0.44          | 0.16  | 0.03            |
| Gensini score | R       |     |               | -0.07 | 0.09            |
|               | P value |     |               | 0.26  | 0.20            |
| EF            | R       |     |               |       | -0.512          |
|               | P value |     |               |       | 0.00            |

\*Spearman correlation coefficient No significant correlation was observed between Gensini score and the number of admissions in the last year ( $R=0.09$ ).

## Discussion

The impact of conduction defect LBBB, RBBB, AV block on mortality and morbidity and its relation to the severity of CAD remain in doubt and controversial. However, the prognostic value

of conduction defect depends on whether it's associated with underlying heart disease studies showed that RBBB had no effect on mortality rate if presented as an isolated conduction defect, but if RBBB, LBBB presented with acute myocardial infarction, it would be a predictor of poor prognosis. In this research, we discuss the angiographic extent and severity of coronary artery disease in patients presenting with ischemic chest pain or shortness of breath who had conduction defects in form of LBBB, RBBB, AV block and its correlation to the left ventricular function, hospitalization and mortality. There is a significant relationship between Gensini score and gender. It is higher in males with a mean of 61.2 in comparison with the females of a mean of 35.8 and  $p$ -value = 0.005 while there is no significant difference among different ages  $< 50$  years old and  $> 50$  years old  $p$ -value = 0.6 including LBBB. Hashemi et al, (2018) did a study on patients with LBBB on electrocardiography either persistent or permanent referred for selective coronary angiography examine Gensini score as a predictive marker for severity of CAD. They elicited no association between severity of CAD and LV systolic dysfunction. Hypertensive patients with LBBB had higher Gensini score regardless of LV systolic function.<sup>38</sup> In contrast a study was done in Erbil, Iraq (2013) with a total of 150 patients with complete LBBB coronary angiography done for all the patients showed DM and Lt ventricular systolic dysfunction were associated with sever CAD. It is more severe among hypertensive patients and diabetic patients, Left anterior descending artery the most involved vessel.<sup>15</sup> Ozcan Ozeke et al (2006) conducted a study in turkey for comparison of CAD severity in LBBB without diabetes and non-LBBB with diabetes include 51 patients with type 2 diabetes and LBBB, the severity of CAD

estimated by Gensini score, LV ejection fraction done by echocardiography. Patients' diabetic with LBBB had a higher Gensini score for severity of CAD and its higher in three vessels disease its significant among diabetic than non-diabetic.<sup>16</sup> This result resembles to the result of the study of Razi UI Amin et al (2019).<sup>17</sup> In Basrah, Iraq, two similar studies were done for the severity of CAD among patients with LBBB, Asaad Hassan Kata (2010) found that 37 patients from 50 with LBBB has severe CAD with significant value and LAD is the most affected vessel with significant LV systolic dysfunction.<sup>18</sup> Mohammed Younes et al, (2015) did their study on 100 patients with LBBB. It showed that LBBB associated with more extensive CAD and poor LV systolic dysfunction and it is more significant among diabetic patients.<sup>19</sup> But they did not include the Gensini score in the estimation of the severity of CAD. A study was done by Amir Farhang Zand parsia, Nov (2011), in Tahrana, Iran. The study involved 172 patients with RBBB, 174 patients without RBBB, the severity of CAD was estimated by Gensini score. There was no significant association between the presence of RBBB and severity of CAD by Gensini scoring. Male gender and diabetic patients had the higher Gensini score. LAD and LCX were the most involved vessels.<sup>20</sup> As in this study, LAD is the most frequently affected vessel that induces RBBB and also responsible for most cases of LBBB due to same reasons, RCA comes in the next level that induces LBBB and RBBB as the fact of blood supply of the LBBB and RBBB.<sup>8</sup> A study was done by Man-Hong Jim et al, (2010) Mar. in Hong Kong. 70 patients with complete AV block were compared with 319 patients with inferior wall myocardial infarction without AV block. It was a case - control study. Patients with complete AV block RCA occlusion with a significant association. It was associated with

large size of infarction and mortality rate was significantly higher. AV block complicated inferior wall infarction improved with reperfusion therapy and did not need permanent pacing.<sup>21</sup> In this study there is no death rate among patients with AV block due to a small sample size. Only 8 patients presented with AV block due to myocardial infarction and underwent a primary PCI. They improved regarding AV block and discharged without permanent pacing. A total of 6 patients (4.7%) out of 127 patients died during the period of the study involving 3 patients LBBB and 3 patients RBBB. There is no study including the rate of hospitalization among patients with conduction defect, but this study showed no significant correlation between the frequency of hospitalization and severity of CAD. Most of the patients admitted once for coronary angiography and discharged without sequels. Most of the male patients with significant Gensini score indicate more severe CAD. This is due to risk factors in males which make them more liable to get CAD than females. Gensini score seems to be higher in three vessel diseases than others and higher in AV block and RBBB than in LBBB. This could be due to 15 patients out of 79 of LBBB who had no vessel disease and Gensini score was equal to zero. This may be due to LBBB, not due to CAD and other cause presented as a conduction system degeneration or cardiomyopathy.

**Conclusion & recommendation,** conduction defect is a serious condition that might need an intervention with revascularization. There is a significant association between the conduction defect and coronary artery disease and a significant association with left ventricular dysfunction especially those symptomatic patients at increased risk of mortality rate. It is recommended to screen for CAD in patients who

have diabetes and hypertension and presented with conduction defect.

**limitation and recommendation of the study:**

This study is limited by a small sample size that was attributed to the global epidemic of covid-19. Different types of conduction defect affect the results. There is a need to take each type of conduction defect separately to focus on analyzed data and need a simultaneous evaluation of the coronary artery disease by another scoring system like syntax score which would be more beneficial to evaluate more association between the severity and extent of CAD among patients with conduction defect on resting electrocardiography.

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### نتائج قسطرة الشرايين التاجية في مرضى المصابين بقطع الحزمة الكهربائية تخطيط القلب الكهربائي

**الخلفية:** خلل الحزمة الكهربائية في القلب هي إحدى الأسباب المؤدية لزيادة نسبة الوفاة و المرضة في العالم بين مرضى القلب والشرايين وهي عامل يدل على سوء تخمين مسار المرض الذي يؤثر على النجاة و يزيد من نسبة الوفيات .

**الهدف من الدراسة:** دراسة العلاقة بين نتائج القسطرة للشرايين التاجية لبيان شدة وامتداد تضيق في الشرايين التاجية عند المرضى المصابين بأمراض الشرايين التاجية و خلل الحزمة الكهربائية .

**المرضى والطرائق:** أجريت الدراسة المقطعية المقارنة في مركز القلب للتداخل القسطاري في مستشفى الصدر التعليمي و مستشفى نفط البصرة لطب وجراحة القلب ما بين الفترة شباط ٢٠١٩ - تشرين الاول ٢٠٢٠ تضمنت الدراسة ١٢٧ مريض كان من بينهم ٨٥ من الرجال و ٤٤ من الأنثى مع متوسط العمر (٦٠,٧ ± ١٠,٥) يعانون من الألم الصدر (٧٦٪) أو ثقل في الصدر (٢٤٪) . تم أخذ التاريخ المرضي لجميع المرضى و عوامل لخطورة لأمراض القلب والشرايين و تم عمل تخطيط القلب لجميع المرضى المصابين بانقطاع الحزمة الكهربائية و تم تصنيفهم حسب معايير معينة من تخطيط القلب الى مجموعة انقطاع الحزمة الكهربائية اليسرى و مجموعة انقطاع الحزمة الكهربائية اليمنى و مجموعة انقطاع الربط الكهربائي بين الاذنين والبطينين. تم عمل تخطيط صدى القلب (دراسة الايكو) لجميع المرضى . تم ادخال جميع المرضى الى تداخل شرايين القلب القسطاري وقيمت الشرايين التاجية من قبل اخصائين لقلب و التداخل القسطاري و تم حساب عامل الجنسيني لجميع المرضى لتقييم شدة وامتداد تضيق الشرايين التاجية. تم استخدام الحزمة الأحصائية للعلوم الاجتماعية الاصدار ٢٥ للتحليل الاحصائي واعتبرت قيمة  $p < 0.005$  ذات دلالة احصائية.

**النتائج:** مرضى المصابين بانقطاع الحزمة الكهربائية لديهم تضيق الشرايين التاجية عالي الشدة والخطورة لاسيما في انقطاع الحزمة الكهربائية اليمنى و انقطاع الربط الكهربائي بين الاذنين والبطينين و هو أكثر حدة في المرضى ذوي امراض الثلاثة شرايين التاجية وقد لوحظ ارتفاع حدة التضيق لاسيما في مرضى المصابين بارتفاع ضغط الدم الشرياني و داء السكري. عامل جنسيني لا يدل على وظيفة القلب وكفاءة عمل البطين الايسر.

**الاستنتاج:** معدل تضيق الشرايين التاجية عالي بشكل ملحوظ في مرضى انقطاع الحزمة الكهربائية بانواعها الثلاثة وتدل على شدة وامتداد التضيق في الشرايين التاجية وخصوصا عند مرضى السكري وارتفاع ضغط الدم.

**الكلمات المفتاحية:** شدة قصور الشرايين التاجية قسطاريا، عطب الحزمة الكهربائية القلبية.