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# Fragmented QRS and Ventricular Arrhythmias in Coroary Artery Disease Patients

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## ABSTRACT

**Background:** Fragmented QRS represents myocardial scar and will be associated with ventricular dysfunction and occurrence of congestive heart failure. In CAD, fQRS represents prior occurrence of myocardial infarction and will have a risk of subsequent occurrence of ischemic events.

**Objective:** in our study we aimed to determine whether fragmented QRS (fQRS) is associated with increased incidence of ventricular arrhythmias in patients with coronary artery disease (CAD) or not .

**Patients and Methods:** one hundred patients with CAD were included. Patients were divided into two groups according to presence or absence of fQRS on admission ECG. Group 1 (n=50) was defined as a fQRS (+ve) and group 2 (n=50) was defined as a fQRS (-ve). All patients were subjected to full history taking, complete physical examination, ECG, echocardiography and laboratory investigations.

**Results:** There was higher incidence of fQRS in hypertensive patients (72%). FQRS was found to be associated with increased incidence of ventricular arrhythmias, 52% in group 1 versus 24% in group II. EF % was significantly lower in group I than in group 2 with p value 0.03. Fragmented QRS was an independent predictor of all-cause mortality with p value 0.02. **Conclusion:** fQRS on the resting surface electrocardiogram is a simple, fast and inexpensive modality of noninvasive investigation for evaluation of CAD patients. Patients who have known CAD present with a fQRS have an increased rate of ventricular tachyarrhythmias, death risk, and low ejection fraction.

**Keywords**: Fragmented QRS, Coronary Artery Disease, Ventricular arrhythmia, Mortality.

## INTRODUCTION

Fragmented QRS complex in patients with CAD was associated with myocardial conduction block due to myocardial scar detected by myocardial single photon emission tomography (SPECT) [(1)].

Fragmented QRS was defined by an additional R wave (R') or notching within the QRS complex. FQRS improved identification of prior myocardial infarction in patients who are being evaluated for CAD [(2)]. Fragmented QRS can be caused by zigzag conduction around the scarred myocardium, resulting in multiple spikes within the QRS complex [(2)].

Fragmented QRS represents myocardial scar and will be associated with ventricular dysfunction and occurrence of congestive heart failure. In CAD, fQRS represents prior occurrence of myocardial infarction and will have a risk of subsequent occurrence of ischemic events [(3)].

FQRS also can reflect intracardiac conduction abnormality and will represent a substrate for ventricular arrhythmia [(4)].The usefulness of fQRS for detecting myocardial scar and for identifying high risk patients has been expanded to various cardiac diseases, such as cardiac sarcoidosis, arrhythmogenic right ventricular cardiomyopathy, Brugada syndrome, and acquired long QT syndrome [(5)].

## AIM OF THE WORK

Determine whether fQRS is associated with increased incidence of ventricular arrhythmias in CAD patients or not.

## PATIENTS AND METHODS

Prospectively we enrolled 100 consecutive patients with CAD patients (with acute or old MI) admitted to intensive care unit in Fayoum University hospital in the period from June 2016 to June 2017. **The study was approved by the Ethics Board of Fayom and an informed written consent was taken from each participant in the study.**

Patients were divided into two groups according to presence or absence of fQRS on admission ECG to:

- group1 (n=50) was defined as an fQRS (+ve).
- group 2 (n=50) was defined an fQRS (-ve).

We excluded from our study patients with electrolytes disturbance and patients with FQRS not complaining of CAD.

After full history taking, complete clinical examination, and routine laboratory investigations; all patients were subjected to the following:

**Electrocardiography (ECG)**

Twenty-lead surface ECG was obtained at admission. (25mm/s, 10 mm/mV). fQRS was defined as the presence of different RSR' patterns which included an additional R wave or notching of the R wave or S wave, or the presence of more than one R' prime without typical bundle branch block in two contiguous leads corresponding to a major coronary artery territory.



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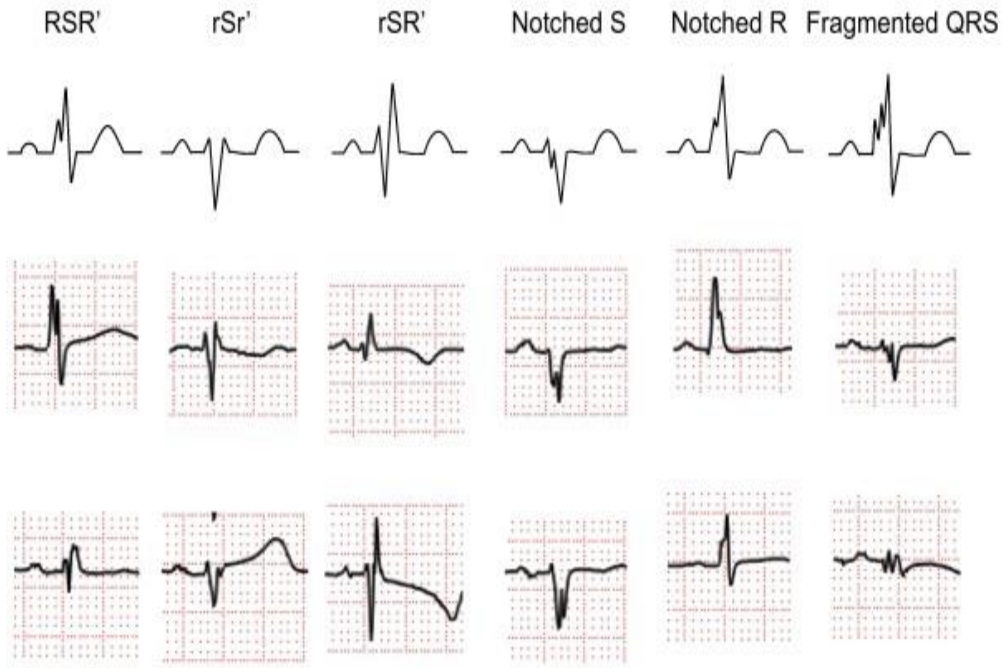



**Figure I: Different forms of fragmented QRS**

**Echocardiography**

Standard transthoracic M-mode, two dimensional and Doppler echocardiographic studies were performed using an ACUSON CV70 Echo Doppler machines equipped with a 2.5\3.2-MHZ annular array transducer measuring the end diastolic (EDD) and end systolic diameters (ESD), Left Atrial Diameter (LAD), Fractional shortening (FS) and ejection fraction (EF).

**Statistical Analysis**

- Data was collected and coded to facilitate data manipulation and double entered into Microsoft Access and data analysis was performed using SPSS software version 18 under windows 7.
- Simple descriptive analysis in the form of numbers and percentages for qualitative data, and arithmetic means as central tendency measurement, standard
- 
- deviations as measure of dispersion for quantitative parametric data, and inferential statistic test:

- **For quantitative parametric data:**
  - In-depended **student t-Test** used to compare measures of two independent groups of quantitative data.
  - **Paired t-test** in comparing two dependent quantitative data.
- **Bivariate Pearson correlation test** to test association between variables.
- The level of $P \leq 0.05$ was considered the cut-off value for significance.

**RESULTS**

The study was conducted on 100 patients with CAD; Table 1 represents their demographic characteristics.

**Table (1): demographic data**

| Variables | Group I (n=50) | | Group II (n=50) | | p-value | Sig |
|---|---|---|---|---|---|---|
| Age (years ) | Mean ± SD | | Mean ± SD | | | |
| | 56.6 ± 13.3 | | 60.2± 11.4 | | 0.2 | NS |
| Sex | | | | | | |
| Male | 30 | 60% | 33 | 66% | 0.7 | NS |
| Female | 20 | 40% | 17 | 34% | | |

**Risk factors**

There was statistically significant difference between study groups as regards HTN with high percentage of hypertensive patients in group I (72%) where in the other group they represent (36%) with p value (0.001) Table (2).

**Table (2): Comparisons of risk factors in different study groups**

| | Variables | Group I (n=50) | | Group II (n=50) | | p-value | Sig. |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | | |
| **Diabetes mellitus** | No | 21 | 42% | 25 | 50% | 0.5 | NS |
| | Yes | 29 | 58% | 25 | 50% | | |
| **Hypertension** | No | 14 | 28% | 32 | 64% | **0.001*** | **HS** |
| | Yes | **36** | **72%** | 18 | 36% | | |
| **Smoking** | No | 33 | 66% | 32 | 64% | 0.9 | NS |
| | Yes | 17 | 34% | 18 | 36% | | |

**Incidence of ventricular arrhythmias:**

There was higher incidence of ventricular arrhythmias in group 1 (52%) versus (24%) in the other group, p value (0.006) as shown in table 3.

**Table (3): Incidence of ventricular arrhythmias**

| Vent. arrhythmias | Group I (n=50) | | Group II (n=50) | | p-value | Sig. |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | | |
| No | 24 | 48% | 38 | 76% | **0.006*** | **HS** |
| Yes | 26 | 52% | 12 | 24% | | |

**Echocardiographic findings**

There was statistically significant difference as regards LVEDD, LVESD and LAD with high values among group (1) as shown in Table 4.

**Table (4): Echo findings in different study groups**

| Echo data | Group I (n=50) | Group II (n=50) | p-value | Sig. |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | | |
| **LVEDD** | 5.9 ± 0.86 | 5.14 ± 1 | **0.001** | **HS** |
| **LVESD** | 4.5 ± 0.95 | 3.8 ± 1 | **0.001** | **HS** |
| **SWT** | 1.02 ± 0.16 | 0.99 ± 0.18 | 0.4 | NS |
| **PWT** | 0.99 ± 0.17 | 0.94 ± 0.17 | 0.2 | NS |
| **LAD** | 4.1 ± 0.71 | 3.8 ± 0.59 | **0.02** | **S** |
| **AO** | 3.01 ± 0.39 | 3.6 ± 3.8 | 0.3 | NS |

**Comparisons between groups regarding EF:**

There was statistically significant difference with p-value 0.03 between study groups as regards EF% as shown in table 5.

**Table (5): EF in different study groups**

| EF | Group I (n=50) | | Group II (n=50) | | p-value |
|---|---|---|---|---|---|
| | No. | % | No. | % | |
| Low EF | **21** | **42%** | 10 | **20%** | **0.03** |
| High EF | 29 | 58% | 40 | 80% | |

**Relation between ventricular arrhythmias and EF**

There was higher incidence of ventricular arrhythmias among patients with low EF (61.3%) versus (27.5%) among patients with normal EF, (p value <0.001).

**Table (6): Relation between ventricular arrhythmias and EF**

| Vent. Arrhythmias | Low EF (n=31) | | Normal EF (n=69) | | p-value |
|---|---|---|---|---|---|
| | No. | % | No. | % | |
| No | 12 | 38.7% | 50 | 72.5% | **<0.001** |
| yes | 19 | 61.3% | 19 | 27.5% | |

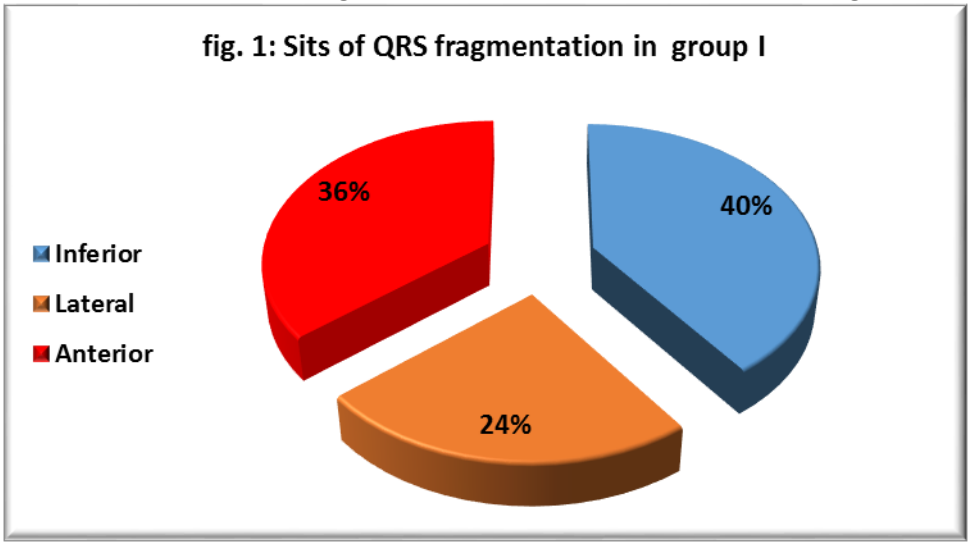
Also we found that patients in group I with low EF had a higher incidence of ventricular arrhythmias than patients with low EF in group II (76.2% vs 30% respectively; P: .02), as shown in table 8.

**Table (7): Comparisons of incidence of ventricular arrhythmias among low EF patients**

| Vent. Arrhythmias in Low EF | Group I (n=21) | | Group II (n=10) | | p-value |
|---|---|---|---|---|---|
| No | 5 | 23.8% | 7 | 70% | **0.02** |
| yes | 16 | 76.2% | 3 | 30% | |

**Site of QRS fragmentation in group I**

By analysis of ECG for the site of fragmentation we found that 40% of patients had inferior fragmentation, 36% of them had anterior fragmentation and 24% of them had lateral fragmentation. As shown in figure 1.




**Relation of ventricular arrhythmias to site of QRS fragmentation**

No statistically significant difference with p-value 0.2 between sites of fragmentation in group I and development of ventricular arrhythmias. As shown in table (9).

**Table (8): Relation of ventricular arrhythmias to site of QRS fragmentation**

| Arrhythmia | **Inferior** (n=20) | | **Lateral** (n=12) | | **Anterior** (n=18) | | **p-value** |
|---|---|---|---|---|---|---|---|
| | **No.** | **%** | **No.** | **%** | **No.** | **%** | |
| No | 12 | 60% | 3 | 25% | 9 | 50% | 0.2 |
| Yes | 8 | 40% | 9 | 75% | 9 | 50% | |

**Mortality in different study groups**

There was a statistically significant difference between study groups regarding mortality with higher incidence of mortality among group I (30% vs 10%**;** p value 0.02) as shown in table 10. But mortality was mostly due non arrhythmic cause as shown in table 11.

**Table (9): Mortality in different study groups**

| **Mortality** | **Group I** | | **Group II** | | **p-value** | **Sig.** |
|---|---|---|---|---|---|---|
| | **No.** | **%** | **No.** | **%** | | |
| Survived | 35 | 70% | 45 | 90% | **0.02** | **S** |
| Not-survived | 15 | 30% | 5 | 10% | | |

**Table (10): Incidence of arrhythmic mortality in different study groups**

| **Arrhythmic mortality** | **Group I** (n=15) | | **Group II** (n=5) | | **p-value** |
|---|---|---|---|---|---|
| | **No.** | **%** | **No.** | **%** | |
| No | 6 | 40% | 2 | 40% | **0.9** |
| Yes | 9 | 60% | 3 | 60% | |

**DISCUSION**

QRS complex fragmentations are frequently seen on routine surface ECG with narrow or wide QRS complex which include paced rhythm, bundle branch block or ventricular premature beats [(6)]**.** Fragmented QRS represents myocardial scar and will be associated with ventricular dysfunction and occurrence of congestive heart failure. In CAD, fQRS represents prior occurrence of myocardial infarction and will have a risk of subsequent occurrence of ischemic events [(3)]**.**

Myocardial scar is a substrate for reentrant ventricular tachyarrhythmia; fQRS also can reflect intracardiac conduction abnormality and will represent a substrate for ventricular arrhythmia [(2)]**.**

Our study was a prospective study which was conducted on 100 critically ill patients with CAD admitted to intensive care unit in Fayoum University hospital in the period from (June 2016 to June 2017).

In our study we aimed to evaluate the relation between fQRS complex in ECG and ventricular arrhythmias in patients with CAD.

Patients were divided into two groups according to presence or absence of fQRS on admission ECG.

- Group I (n=50) was defined as fQRS (+ve).
- Group II (n=50) was defined fQRS (-ve).

**Fragmented QRS and risk factors**

In our study we found that there was statistically significant difference between study groups as regards exposure to HTN with high percentage of hypertensive patients in group I (72% vs 36% in group II, p 0.001).

In agreement to our study, **Eyuboglu *et al.*** [7] in a study conducted on 548 patients found that The frequency of fQRS was significantly higher in hypertension patients than normotensive patients (36.4% vs 17.6%, *P*<.05) and fQRS may be a sign of increased blood pressure and may predict higher fibrotic burden in patients with hypertension.

**Kadi *et al.*** [8] reported that the fQRS is frequently observed in hypertensive patients without CAD as a result of the myocardial fibrosis.

We also found in our study as regarding DM and smoking risk factors that there was no statistically significant difference between the study groups.

**Sharma *et al.*** [9] reported that past history of HTN, DM, and were insignificant in both groups, but they reported increased incidence of smoking in their positive fQRS group. This comes in contrast to **Alattar *et al.*** [10]; where they found that fQRS patients have higher prevalence of diabetes (58% vs. 44% in non-fQRS group; p=0.045).

**Fragmented QRS and ventricular arrhythmias:**

In our study we found that there was a significant difference between study groups as regards incidence of ventricular arrhythmias. Fifty two (52%) of patients of group I developed ventricular arrhythmias versus (24%) of group II, p 0.006.

This is in agreement with **Mithilesh and Douglas** [11] in their study which was conducted on 361 patients with CAD and DCM who received an implantable cardiovertor defibrillator for primary or secondary prophylaxis. They found that fQRS in the 12 lead ECG is a predictor of arrhythmic events in these patients and associated with significantly decreased time to first arrhythmic event compared to non fQRS group.

**Qin-hui** [12] in **2013** showed that the positive fQRS group had higher rates in malignant cardiac arrhythmia and left ventricular systolic dysfunction (LVSD) than the non-fQRS group ($p<0.05$). The STEMI patients with positive fQRS had four times the incidence of malignant cardiac arrhythmia in comparison to the non-fQRS group ($p<0.01$) The rate of LVSD of the fQRS group was 7.5 times higher than that of the non-fQRS group ($p<0.01$).

**Comparison of echocardiographic parameters in both study groups:**

In our study we found a statistically significant difference between the two groups as regards (LVEDD, LVESD and LAD) with high values in group I vs II of LVEDD (5.9±0.86cm vs 5.14±1cm, p 0.001), LVESD (4.5±0.95 cm vs 3.8±1cm, p 0.001) and LAD (4.1±0.71 cm vs 3.8±0.59 cm, p 0.02).

Similarly **Tikkanen *et al.*** [13] in a study conducted on 542 patients they found that LVESD, LVEDD were statistically higher in fQRS(+ve) group compared to the fQRS(-ve) group,3.4± 0.61 vs 3.23 ±0.54 and 4.91 ± 0.55 versus 4.78±0.47 respectively, but they found that there was no difference between the two groups as regards LAD. They also found inverse relation between fQRS and LVEF and this comes in agreement to us where we found that there was statistically significant difference with p; 0.03 between study groups as regards percentage of patients with low EF (42% in group I vs 20% in group II). **Alattar *et al.*** [10] was in agreement with our results in a study conducted on 500 patients where they found that fQRS is associated with lower EF in all CHF patients admitted to the hospital (44% vs 36% in non-fQRS. **Akbarzadeh *et al.*** [14] found that there was no significant difference in EF between patients with and without fQRS on first admission and at 2 months follow up in their study. However, at 6 months follow up, the left ventricular EF in patients with fQRS was significantly lower than that in those without fQRS, and those with fQRS at the 2 months follow up had a higher risk of developing left ventricular dysfunction at the 6 months follow up.

**Localization of fragmentation in EGG:**

In our study we found that 40% of patients with fQRS had inferior fragmentation, 36% had anterior fragmentation and 24% of them had lateral. We have difference but not statistically significant may be due to our small sample size.

**Qin-hui *et al.*** [12] on a study conducted on 300 patients showed that there was an 81.1% incidence rate of fQRS in the inferior lead , which was significantly higher than the rates observed at the anterior and the lateral chest wall. **Imran *et al.*** [15] also in study conducted on 269 patients found that fQRS was seen in inferior lead vs anterior lead vs lateral lead were 73%, 38%, and 38% of ECGs, respectively.

**Fragmented QRS and mortality**

In our study we found that all-cause mortality was higher in group I compared to group II (30% vs 10%, p; 0.02) ,but we found that there was no statistically significant difference between study groups as regards arrhythmic mortality( p; 0.9).

In accordance with us **Tikkanen *et al.* [13]** in a study conducted on 542 patients found that the rate of mortality was found to be higher in the fragmented group than in the non-fragmented group (11.8%) vs (6.2%) with p value (0.028). **Das *et al.* [3]** demonstrated that, the presence of fQRS was associated with higher all-cause mortality (34% vs 26% in patients without fQRS) and cardiac event rate defined as MI, cardiac death and need for revascularization (50% vs 28% in patients without fQRS). **Rosengarten *et al.* [16]** showed also a higher rate of sudden cardiac death (40%) in patients with fQRS. In contrast to us, **Jabeur *et al.* [17]** In a prospective study of 300 patients they found that presence of fQRS on ECG was not associated with a higher risk of either all-cause or arrhythmic mortality. Rates of all-cause mortality did not differ between the fQRS+ (18.4%) and fQRS- (23%) group, P value = 0.43. Additionally, rates of arrhythmic mortality were similar between the fQRS+ (8.7%) and fQRS- (10.7%) groups, P = 0.38. In our study we found that there was no relation between the site of fQRS in 12 lead ECG and incidence of ventricular arrhythmias and mortality. In contrast to us **Vandenberk *et al.* [18]** where they reported that inferior fQRS was a predictor of early arrhythmia, while anterior fQRS was related to mortality. This difference between our results and their results may be due to our small sample size and short period of follow up.

## CONCLUSION

Fragmented QRS on the resting surface ECG is a simple, fast and inexpensive modality of noninvasive investigation for evaluation of CAD patients. Patients who have known CAD present with a fQRS demonstrated increased rates of ventricular tachyarrhythmias, death risk, and low EF. There was higher incidence of fQRS in hypertensive patient.

## RECOMMENDATIONS

For better prediction of prognosis and improvement of diagnosis, objective evaluation and qualitative analysis of fQRS is required. Using magnetic resonance imaging or myocardial perfusion scintigraphy to detect myocardial abnormalities attributable to fQRS. Apply the study on various non CAD diseases and large patient sample.

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