Relationship Between Changes in R-wave Amplitude During Left Ventriculography and the Seriousness of Coronary Heart Disease

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Serious complications, such as myocardial infarction or death, may occur particularly in patients with severe coronary heart disease during coronary angiographies. Therefore, prediction of severe coronary heart disease before or during the initial steps of the procedure can provide a decrease in frequency of such complications. To predict the seriousness of coronary heart disease during left ventriculography, before, during, and after the application of contrast matter, electrocardiography (ECG) records were taken and R-wave amplitudes were measured. Lead DII was used for calculations. The patients were classified according to vessel lesions and were compared with the control group. Before and after left ventriculography, there was no significant difference between the groups with normal coronary arteries and one, two, or three vessel lesions. Although there was no significant difference obtained from the comparison of the control group and the groups with one-vessel and two-vessel lesions (9.7 mm, 9.2 mm, 10.1 mm, respectively, $P > 0.05$); there was statistical difference between the group with three-vessel lesions and the control group during left ventriculography (6.4 mm, 9.7 mm, respectively, $P < 0.05$). Nonionic contrast material was used in all procedures. The decrement of R-wave amplitude that is observed during left ventriculography can predict three-vessel disease, which is a more serious condition for the patients. These patients should be monitored more carefully during coronary angiographies.

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Coronary angiography is accepted as the method that gives the best results in the diagnosis of coronary artery disease. But, some serious complications, such as myocardial infarction (MI) and death, can be observed with patients who suffer severe coronary artery disease.¹⁻³ Also, some problems may be encountered with the interpretation of coronary angiography results. Certain important lesions may not be noticed or different opinions may be revealed about the seriousness of some lesions. For this reason, before or in the earlier steps of coronary angiography, estimation of serious coronary artery disease will reduce the com-

plications depending on a more careful application and the results will be interpreted more carefully.

In this study, 180 patients suspected of having coronary artery disease had coronary angiography. During left ventriculography, before, during and just after the injection of the contrast matter, electrocardiography (ECG) records were taken and R-wave amplitudes were measured.

METHODS

The patients admitted to our department with a prediagnosis of coronary artery disease between June 1998 and January 1999 were included in this

Figure 1. ECG records of a patient with one-vessel disease. A. before ventriculography; B. during ventriculography; C. after ventriculography.

study. Of these patients, 138 were male and 42 were female, aged between 41 and 69 (53 ± 11).

Patients with congenital heart disease, valvular heart disease, cardiomyopathy, chronic renal failure, malignant disease, or metabolic diseases, and patients with atrial fibrillation were excluded from the study.

One hour before coronary angiography, ECG records with 12 derivations were received. After local anesthesia, ventriculography and selective coronary angiography was performed using standard Judkins catheters via femoral artery, and or via brachial artery in some occasions. We used nonionic contrast material, Iohexol (Omnipaque: 350 mg/mL, 0.78 osm/kg H_2O at $37^\circ C$) in all patients and controls. Before, during, and after left ventriculography, nonionic contrast matter was given, ECG records were taken, and R-wave amplitudes were measured (Figs. 1–4). ECG records were taken 10 mm/mV of amplitude and 25 mm/

sec of rate, and R amplitude values were calculated from the ECG records, during and after left ventriculography. The R wave was calculated by ruler from an average of at least five consecutive beats in patients with sinus rhythm. DII lead were used for this purpose. To improve accuracy, measurements were performed with calipers and magnifying lens for defining the ECG deflection. Two different cardiologists who had no knowledge of each other and clinical status of the patients examined these records. Intra- and interobserver variability were lower than 3%.

The lesioned vessel was accepted if the luminal narrowing of a coronary artery was $\geq 70\%$.

Statistical Methods

Student *t* test and one way ANOVA test were used for statistical analysis.

Figure 2. ECG records of a patient with two-vessel disease. A. before ventriculography; B. during ventriculography; C. after ventriculography.

RESULTS

Twenty-seven patients (21 male and 6 female, average age: 53 ± 7) had one-, 34 patients (29 male and 5 female, average age: 55 ± 8) had two-, and 66 patients (55 male and 11 female, average age: 52 ± 12) had three-vessel lesions. The coronary angiographies of 53 patients (33 male and 20 female, average age: 53 ± 6) were normal.

Of the patients who had three-vessel disease, 45 were diagnosed with stable and 20 with unstable angina pectoris. Of the group with two-vessel lesions contained 20 patients with a diagnosis of stable and 18 with unstable angina pectoris. The patients with one-vessel pathology, 11 were diagnosed stable and 13 with unstable angina pectoris. Twenty-three patients whose coronary angiography was normal had stable while 17 had unstable angina pectoris. The number of patients who had history of MI was 31, 9, and 13 as they had three-, two-, and one-vessel lesions, respectively (Table 1). Before, during, and after left ventriculography, two different cardiologists measured R-wave ampli-

tudes by taking ECG records from DII derivation (Table 2) which has been widely used to monitor the patients during coronary angiography.

When we classified the patients according to vessel lesions and compared them with the control group, we found no significant differences between the controls and patient groups before and after left ventriculography (9.8 mm vs 9.8 mm for controls, 9.1 mm vs 9.1 mm for one-vessel disease, 10.3 mm vs 10.2 mm for two-vessel disease, and 10.4 mm vs 10.3 for three-vessel disease, respectively; $P > 0.05$ for all groups, Table 2).

Also, when we compared the control group with the groups containing one- and two-vessel lesions during left ventriculography, we were unable to find any significant differences (9.7 mm, 9.2 mm, 10.1 mm, respectively, $P > 0.05$, Table 2). But when the control group was compared with the group which had three-vessel involvement during left ventriculography, a meaningful difference was obtained between these two groups (9.7 mm and 6.4 mm, respectively, $P < 0.05$, Table 2).

Figure 3. ECG records of a patient with three-vessel disease. A. before ventriculography; B. during ventriculography; C. after ventriculography.

Finally, the R-wave amplitudes decreased only during left ventriculography in patients with three-vessel disease. Also, when we compared the control group (patients with normal coronary arteries) to the patients with history of MI ($n = 53$) during left ventriculography, we recorded significant decrease in the R-wave amplitude in the group with MI (9.7 and 5.6, respectively, $P < 0.005$). On the other hand, there was no meaningful difference between these groups before and after left ventriculography ($P > 0.05$).

DISCUSSION

It is known that during coronary angiography, some complications may occur including myocardial perforation, rhythm conduction disorders, vessel wall damage. Because of this, if coronary artery disease were estimated during left ventriculography before coronary angiography, it would be eas-

ier to prevent these complications. Left ventriculography may reveal some knowledge about coronary arteries.

The risk of coronary angiography results from its nature, the contrast medium used, and the X-radiation to which the patient is subjected. In general, the latter factor, though usually ignored, the risk of the procedure is related to the patient's clinical status. Subjects with advanced coronary disease (left main stenosis or triple vessel disease), poor cardiac function, severe valvular disorders, pulmonary hypertension, and those who are very elderly may be considered to be at increased risk. Serious complications of this procedure are relatively infrequent.

Major complications during coronary angiography are infrequently seen including death, MI, cerebrovascular accident, arrhythmias, vascular complications, hemorrhage, and contrast medium-related complications.⁴

Figure 4. ECG records of a patient with normal coronary arteries. A. just before ventriculography; B. during ventriculography; C. just after ventriculography.

It is well known that changes in intracardiac volume⁵ and R-wave amplitude⁶ may reflect myocardial ischemia. To avoid the amplitude of R wave due to different contrast materials, we used only

one type nonionic contrast material, Iohexol (Omnipaque: 350 mg/mL, 0.78 osm/kg H₂O at 37°C).

In this study, the decrease observed in the R-wave amplitude during left ventriculography in the group containing three-vessel lesions associated with history of MI was significant when compared to the control group (5.6 and 9.7, respectively, $P < 0.05$). Finally, decrement of the R-wave amplitude during left ventriculography may be revealed as these patients have more complex lesions such as left main coronary disease or triple vessel disease.

Complications secondary to coronary angiography have been rarely reported in the literature.⁷ According to some reports, ECG changes may be related to wall abnormalities of the left ventricle.^{8,9} In general, left ventriculography is applied before coronary angiography in many invasive laboratories, and in some other centers it is applied after. According to the results of this study, applying left ventriculography before coronary angiography

Table 1. Demographic Properties of the Patients and Controls

	3-Vessel	2-Vessel	1-Vessel	Control
SAP	45	20	11	23
UAP	20	18	13	17
MI	31	9	13	—
Hypertension	27	17	10	18
DM	8	3	2	3
Dyslipidemia	26	11	5	5
Smoking	25	18	13	16
History	24	9	10	14

SAP = stable angina pectoris; UAP = unstable angina pectoris; MI = myocardial infarction; DM = diabetes mellitus.

Table 2. R Wave Alterations Before, During, and After Ventriculography

	Before Ventriculography	During Ventriculography	After Ventriculography	P Value
1-vessel	9.1 ± 3.1	9.2 ± 3.2	9.1 ± 3.2	NS
2-vessel	10.3 ± 2.9	10.1 ± 3	10.2 ± 2.9	NS
3-vessel	10.4 ± 3.1	6.4 ± 3.6	10.3 ± 3.2	<0.05
Control	9.8 ± 2.9	9.7 ± 2.8	9.8 ± 3	NS

P < 0.05. Statistically significant compared to preventriculography.

would be more useful. Decreasing of R-wave amplitude during left ventriculography may be related to abnormalities of the left ventricular wall motion secondary to MI. Moreover, it may indicate the patients have either left main coronary artery disease or three-vessel disease.

As a result, the decrement of R-wave amplitude observed during left ventriculography shows that coronary artery disease with or without MI is more serious. This suggests the need of more careful examination of coronary arteries and complications of coronary angiography and the interpretation of angiography results.

Limitations

This study has some limitations. We obtained a 12-lead ECG just before ventriculography, however we did not perform it during and after the procedure. The R waves were calculated from only lead DII, since that lead is commonly used to monitor most of the patients who are undergoing coronary angiography. This is a main limitation of this study. Secondly, this study group had no patients with left main coronary artery disease.

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