

Ventricular Arrhythmia Onset During Diagnostic Coronary Angiography With a 5F or 4F Universal Catheter

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Of 18 365 patients who underwent coronary angiography with a 4F or 5F universal catheter between April 2004 and May 2007, 24 (0.131%) experienced sustained ventricular tachycardia or ventricular fibrillation during the procedure. There was no significant difference in any clinical or angiographic characteristic between patients who had a ventricular arrhythmia and those who did not. Of the 24 episodes of ventricular arrhythmia, 14 were related to catheter manipulation, 8 to ischemia, and 2 to the contrast medium, while the cause could not be clearly established in 4. The incidence of ventricular arrhythmia with a universal catheter was 0.131%, and with a preformed catheter, 0.054% ($P=.72$). The study shows that serious ventricular arrhythmia occurs only rarely as a complication when coronary angiography is carried out using modern techniques and that imperfect manipulation of the catheter explains most episodes.

Key words: Ventricular arrhythmia. Coronary angiography. Universal catheter.

Arritmias ventriculares durante angiografía coronaria diagnóstica con catéter universal de 4 o 5 French

De 18.365 pacientes sometidos a angiografía coronaria (AC) con catéteres universales de 4 o 5 F entre abril de 2004 y mayo de 2007, 24 (0,131%) sufrieron taquicardia ventricular (TV) o fibrilación ventricular (FV) durante el procedimiento. No se encontraron diferencias significativas entre las características clínicas o angiográficas de los pacientes que sufrieron arritmias ventriculares (AV) y los que no. De los 24 episodios de AV, 14 estuvieron relacionados con la manipulación, 8 con isquemia y 2 con el medio de contraste; en 4 casos no fue posible establecer relaciones claras. La incidencia de AV con catéteres universales y preformados fue del 0,131 y el 0,054% ($p = 0,72$), respectivamente. Nuestro estudio muestra que las arritmias ventriculares graves son complicaciones poco frecuentes durante la angiografía coronaria realizada con técnicas modernas y que la manipulación inadecuada del catéter explica la mayoría de los episodios de AV.

Palabras clave: Arritmias ventriculares. Angiografía coronaria. Catéter universal.

INTRODUCTION

Although occurrence of ventricular arrhythmias (VA) during coronary angiography (CA) have been previously reported, most of these studies are over a decade old. Recently, with the increasing use of radial approaches, the 5F or 4F universal catheters were widely used during CA. It has been reported that the use of small size and universal catheters can reduce access-site complications,^{1,2} simplify the procedures of catheter manipulation and shorten the time of x-ray exposure.³

However, its influence on episodes of VA hasn't been discussed so far. Therefore, in this report, we analyzed the clinical data of CA patients using 5F or 4F universal catheter and tried to understand the incidence, predictor and possible causes of VA with this contemporary technique.

METHODS

Patients

From April 2004 to May 2007, a total of 26 599 patients (19 106 patients by radial approaches and 7493 patients by femoral approaches) received CA in our center. The 5F (18 346 patients) or 4F (19 patients) universal catheters were used in 18 365 patients which included 1225 patients with BRACHIAL catheter (Medtronic, Inc.), 16 543 patients with TIG catheter (Terumo Corporation, Japan), and 597 patients with MITSUDO-K40 catheter (Hanako Corporation, Japan); 5F no-universal catheters (JL, JR

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and AL) were used in 1837 patients. Non-ionic contrast medium (Ultravist 370 or Omnipaque) were used in all patients with CA.

Date Collection and Definitions

This data collection was from the catheterization laboratory computerized database and medical records at our center. All VAs were diagnosed by 3-lead electrocardiogram (ECG) monitor. The cine angiograms, ECG, and medical records of all patients with VA were reviewed by 2 experienced doctors.

A diseased coronary artery was defined as a $\geq 50\%$ narrowing of the luminal diameter. Manipulation-related VA was defined as a VA associated with improper catheter manipulation or contrast medium injection. Superselective intubation meant that the catheter was inserted into the branch of right or left coronary artery (often conus branch) and deep intubation means that the catheter is inserted deeply into the right or left coronary artery (not inserting branch). We considered the episode of VA is ischemia-related when marked ST segment depression, catheter occlusion or coronary artery spasm is found before the onset of VA. If the VA occur during or less than 10 seconds after injection and some typical electrocardiogram changes (such as bradycardia, QT interval prolongation, T-wave amplitude, rotation of QRS axis, and PR prolongation) are simultaneously observed before the onset of VA, we considered that the VA was contrast-related.

Statistical Analysis

Quantitative variables were presented as mean (standard deviation [SD]) and categorical variables as percentage. Student's *t* test was used to compare the difference in parametric data and χ^2 analysis was used to analyze the nonparametric data. We used SPSS 11.5 for statistical analysis. A *P* value less than .05 was considered statistically significant.

RESULTS

Among 18 365 patients undergoing CA using 5F or 4F universal catheter, ventricular tachycardia (VT) or ventricular fibrillation (VF) was documented in 24 patients (0.131%, 15 VF and 9 VT), VA developed during right coronary artery (RCA) procedures in 18 patients, left coronary artery (LCA) procedures in 5 patients, and after CA procedure in 1 patient.

Among 24 VA patients, 13 VF patients received defibrillation within 1 minute and successfully returned to sinus rhythm; 1 VF patient returned to sinus rhythm after a thump-version. Ten patients experienced nonsustained VT, lasting more than 2 seconds. All VA patients didn't have prior history of malignant arrhythmia and were discharged alive without complications or reoccurrence VA during hospitalization.

Table 1 lists the basic clinical and coronary angiographic characteristics of the VA and no-VA patients. Our data showed that there wasn't significant difference between the 2 groups.

The possible causes of VA are showed in Table 2. Most VAs were manipulation-related.

The incidence of VA are in 5F universal (Judkins and Amplatz) and no-universal catheters (TIG, BRACHIAL and MITSUDO-K40) were 0.131% (24/18346) and 0.054% (1/1837) (*P*=.72).

DISCUSSION

In our data, the incidence of VA during CA using 5F or 4F universal catheter was lower than previous studies.^{4,5} New nonionic contrast agents lowered the incidence of VF^{6,7}; a smaller size catheter can reduce the incidence of catheter occlusion, and it also tends to reduce the volume of contrast material injections as well. We consider that these contribute mainly to the decreased incidence.

Similar to previous studies,⁵ the episode of VA was more frequent during RCA procedures than LCA procedures. In our data, there was no episode of VA during vein bypass grafts procedures, which was different from previous reports; we considered that the lower incidence of VA occurrence, small sample, and the use of smaller size catheter could contribute to the observed difference between the present study and previous reports. After a comparison of VA and no-VA patients, we didn't find any clinical and angiographic characteristics that predicted the episodes of VA; but a trend was noted toward more frequent episodes of VA in 3-vessel disease patients. As a result of retrospective analysis, our conclusion should be tested by a large prospective randomized study.

The causes of VA during CA had been described previously. Early reports^{5,8,9,10} suggested that, although VA could be caused by ischemia or mechanical complications, almost all VAs were associated with contrast medium toxicity. In our data, most episodes of VA were manipulation-related. We speculated that the use of small size and universal catheter could contribute mainly to this change.

Acute ischemia was another important cause that was related to the episodes of VA in our study. Transient ischemia is common and often manipulation-induced (catheter occlusion, catheter stimulation, and long injection) during CA procedures. How to decrease ischemia is also an important consideration for reducing the possibility of VA, especially in the patients with a severe coronary artery disease. In our data, only 2 episodes of VA were contrast-related. We considered that contrast medium toxicity was not mainly cause of VA attack after use of new nonionic contrast medium and small size catheter.

VA might occur without warning; it was not always so easy to analyze the specific causes and its relation of each CA procedure. Ischemia and contrast medium could

TABLE 1. The Comparison of Basic Clinical Characteristics and Angiography Characteristics Between VA Group and No-VA Group

	VA Group (n=24)	No-VA Group (n=18 341)	P
Basic clinical characteristics			
Age, mean (SD), y	58.5 (11.4)	57.7 (10.9)	1
Men, %	83.3	78.7	.582
History			
History of AMI, %	29.2	32.8	.720
History of revascularization, %	20.8	20.7	1
History of CABG, %	0	2.3	1
History of PCI, %	16.7	18.5	1
Risk factor			
Hypertension, %	50	53.8	.709
Hypercholesterolemia, %	33.3	33.1	.981
Diabetes mellitus, %	12.5	19.1	.603
Smoking, %	33.3	45.7	.224
Left ventriculography			
Cardiac dilatation, %	12	13	1
Ejection fraction ≤40%, %	8	8.1	1
Angiographic characteristics			
Coronary artery disease			
3-Vessel disease, %	45.8	30.1	.093
2-Vessel disease, %	16.7	22.2	.514
Single-vessel disease, %	8.3	21.1	.125
No-vessel disease, %	29.2	26.6	.776
Left main artery lesion, %	16.7	9	.269
Total occlusion lesion, %	20.8	10.8	.173
Coronary artery dominance			
Right-dominant, %	95.8	89.6	.506
Left-dominant, %	0	5.6	.643
Balanced, %	4.2	4.8	1
Congenital anomalies, %	0	1.4	1

AMI indicates acute myocardial infarction; CABG, coronary artery bypass grafting; PCI, percutaneous coronary intervention; VA, ventricular arrhythmias.

TABLE 2. An Analysis of Possible Causes of VA During Coronary Angiography Using 5F or 4F Universal Catheter

Possible Causes of VA	VA (n=24)
Manipulation-related VA	14
Catheter superselective intubation	9
Catheter deep intubation	2
Catheter occlusion	2
Catheter stimulation	1
Ischemia-related VA	8
Contrast-related VA	2
Unclear causes	4

VA indicates ventricular arrhythmias.

make myocardium more susceptible to VA and certain transient event such as improper manipulation and acute ischemia could play an important role in triggering VF attack. Some of episodes of VA involved multiple mechanisms. These indicated that we should take multiple factors into comprehensive consideration to prevent this troublesome complication.

Although there was no significant difference in incidence of VA between universal and no-universal catheters, universal catheters tended to have more frequent episodes of VA than non-universal catheters. According to our experience, it was easier and more frequent to obtain good coaxiality and backing out of RCA during vigorous injection with a JR catheter than with universal catheters. The universal catheters with long-tip are not especially designed for right or left coronary artery, so it is easier to perform a superselective (often conus branch) or deep intubation. It is well known that VA often occurs during intracoronary rapid flush of contrast medium on the condition of superselective or deep intubation. In addition, a small size catheter with excessive engagement and a poor coaxiality could lead to a vessel dissection following a sudden and forceful injection.

In summary, with the use of new nonionic contrast and 5F universal catheter, VAs are infrequent and most episodes of VA are manipulation-related. Mainly procedural details to reduce the possibility of VA include avoidance of superselective or deep intubation in RCA angiography; avoidance of a rapid flash of contrast medium injection when the tip position of a catheter is

unclear, paying more attention on severe coronary artery diseases patients and avoidance of a slow prolonged contrast medium injection or catheter occlusion in these patients.

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