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RESEARCH LETTER

Comprehensive Assessment of Coronary Artery Disease in Sports-Related Sudden Cardiac Arrest

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Despite the cardiovascular benefits of regular sports, sudden cardiac arrest (SCA) risk is increased during or shortly after exercise. Association with coronary artery disease (CAD) has been described in small studies, mainly autopsic with potential bias given the high sports-related SCA survival, and focusing on young competitive athletes, whereas sports-related SCA occurs mostly in recreational athletes.[1–5] Through the Paris Sudden Death Expertise Center prospective registry that includes all SCAs in Paris and suburbs since May 2011, we performed the first broad comprehensive CAD description in sports-related SCAs, with a comparison with matched non–sports-related SCAs.

The Sudden Death Expertise Center registry prospectively includes all patients presenting with SCA in Paris and its suburbs since 2011. It is conducted according to the Declaration of Helsinki, with the approval of the Committee for the Protection of Human Subjects in Biomedical Research and the French data protection committee (Commission Nationale Informatique et Liberté). In the current analysis, sports-related SCA was defined as SCA during sport activities or within 1 hour of sports cessation. The decision to perform coronary angiography was left to managing physicians' discretion. Adult patients with sports-related SCA who underwent coronary angiography were matched on age and sex to adult patients with non–sports-related SCA (1:3 ratio). Angiograms were analyzed by 2 independent interventional cardiologists, blinded to exercise status (3 in case of disagreement). Obstructive CAD was defined by >50% stenotic narrowing on at least 1 coronary artery, and considered multivascular if >1 artery was involved. Coronary occlusion was defined by Thrombolysis in Myocardial Infarction flow grade 0 to 1, and considered recent if no collaterals were present and the wire crossed it easily during angioplasty. A culprit lesion was defined by thrombus presence, flow reduction Thrombolysis in Myocardial Infarction flow grade <3, or acute coronary occlusion, according to non–ST-segment–elevation myocardial infarction guidelines. Conditional logistic regressions were used to compare matched groups (2-sided, level of significance $P<0.05$).

Of the 13 400 SCAs identified, 154 were sports related. They were at younger ages than non–sports-related SCAs (median age: 51.2 [40.8–60.7] versus 69.8 [57.0–81.4] years, $P<0.001$), with a higher proportion of males (96.1% versus 64.1%, $P<0.001$). Coronary angiography was performed in 83 patients with sports-related SCAs, who were matched with 249 patients with non–sports-related SCA having coronary angiographies.

In the matched populations, there was no difference in ST-segment elevation or presumed new left bundle-branch block rates (47.9% versus 49.3%, $P=0.70$). The rate of CAD was similar (71.1%), with similar rates of obstructive CAD (68.7% versus 67.5%, $P=0.81$), chronic coronary occlusions (15.7% versus 20.7%, $P=0.28$), and multivessel CAD (45.6% versus 54.4%, $P=0.32$). The presumed cul-

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prit coronary lesion, mostly left anterior descending artery (64.4% versus 58.1%, *P*=0.71), was more often identified in sports-related SCAs (54.2% versus 42.2%, *P*=0.04). It was associated with apparently chronic CAD in 42 sports-related (93.3%) versus 226 (90.8%) non–sports-related SCAs (*P*=0.27), and with multivessel disease in 19 (42.2%) sports-related versus 50 (47.6%) non–sports-related SCAs (*P*=0.33) (Table).

Among the 57 sports-related SCAs with obstructive CAD, only 5 (6.1%) had known CAD. At least 1 cardiovascular risk factor was known in 33 (57.8%) cases. Symptoms were assessed in 31 (54.4%) cases; 22 (71.0%) presented at least 1 symptom within 4 weeks before SCA. Symptoms, mainly intermittent chest pain (18 patients, 81.2%), started >1 hour before SCA in 11 patients (50.0%). Only 11 (50.0%) called emergency medical services before SCA. Among symptomatic patients with sports-related SCAs, 81.3% presented with CAD on coronary angiography.

In this first comprehensive assessment of CAD in all-comers SCA, sports- and non–sports-related SCAs surprisingly presented the same CAD angiographic pattern in terms of chronic obstructive CAD, chronic occlusions, and multivessel disease. Despite a very low rate of known CAD before sports-related SCA, acute culprit lesions were associated with chronic lesions in >90%. Most patients with sports-related SCAs presented symptoms before SCA, in particular, when CAD was present. However, they maintained physical activity, and only half called emergency medical services before SCA, highlighting the lack of CAD symptoms awareness.

CAD-associated sports-related SCA occurred with 2 lesion types. Half occurred with severe stable coronary stenosis; mismatch between myocardial oxygen supply and demand might have induced myocardial ischemia and ventricular arrhythmias. The second half, traditionally considered as the classical CAD-related SCA in sports, fulfilled the unstable culprit lesion criteria. Shear forces might have induced plaque rupture through increased vascular wall stress. It is interesting to note, in our study, that the plaque ruptures most frequently occurred with pre-existing CAD and associated multivessel disease, showing that sports-related SCAs are not only attributable to shear stress but also diseased coronaries.

Among limitations, CAD was not assessed in patients dead before coronary angiography because of the lack of autopsy. However, they did not present differences in median age and sex ratio with patients undergoing angiography (52.2 versus 51.4 years, *P*=0.98, and 97.6% versus 95.4% males, *P*=0.65, respectively). Second, intracoronary imaging was not performed, limiting plaque analysis. Third, the causal effect of CAD could not be confirmed when no thrombus was found, and was an exclusion diagnosis.

Table. Characteristics, Angiographic Findings, and Outcome According to Occurrence During Sports Matched by Age and Sex

	n	Sports-Related SCA n=83	Non–Sports-Related SCA n=249	*P* Value*
Age, y	332	52.0 (41.8–60.1)	52.0 (41.4–60.1)	
Male sex	332	81 (97.6)	243 (97.6)	
Medical history				
Known heart disease	322	12 (14.6)	65 (27.1)	0.02
Known coronary artery disease	322	5 (6.1)	45 (18.8)	<0.01
Risk factors				
Current smoking	298	18 (24.0)	117 (50.2)	<0.01
Diabetes mellitus	317	4 (4.9)	41 (13.1)	0.04
Hypercholesterolemia	317	22 (27.2)	80 (33.9)	0.19
Hypertension	317	22 (27.2)	63 (26.7)	0.98
Characteristics of cardiac arrest				
Initial shockable rhythm	327	68 (86.1)	182 (73.4)	0.02
ST elevation (ECG after ROSC) †	280	35 (47.9)	102 (49.3)	0.70
Angiographic data				
Normal angiogram	332	24 (28.9)	72 (28.9)	1.00
Obstructive coronary lesion	332	57 (68.7)	168 (67.5)	0.81
Coronary lesion location	225			0.32
Single-vessel disease		31 (54.4)	77 (45.8)	
Multivessel disease		26 (45.6)	91 (54.2)	
Chronic coronary occlusion	329	13 (15.7)	51 (20.7)	0.28
Presumed culprit lesion	332	45 (54.2)	105 (42.2)	0.04
Associated with chronic CAD	150	42 (93.3)	226 (90.8)	0.27
Associated with MVD	150	19 (42.2)	50 (47.6)	0.33
Location	150			0.71
Left main		3 (6.7)	5 (4.8)	
Left anterior descending		29 (64.4)	61 (58.1)	
Circumflex		4 (8.9)	21 (20.0)	
Right coronary		9 (20.0)	18 (17.1)	
Outcome				
Survival at hospital discharge	327	52 (65.8)	110 (44.4)	<0.01
Survival with CPC 1 or 2	318	45 (60.0)	102 (42.0)	<0.01

Values are median (25–75th percentile) or patients, n (%). Percentages were calculated on the basis of the total number of known events. CAD indicates coronary artery disease; CPC, Cerebral Performance Category; MVD, multivessel coronary disease; ROSC, return of spontaneous circulation; and SCA, sudden cardiac arrest.

*Conditional logistic regression.

†Among patients with ROSC (n=300 including 75 sports-related cardiac arrests).

In conclusion, patients with sports-related SCA presented CAD with the same frequency and pattern in comparison with non–sports-related SCA, with a higher prevalence of culprit lesions. CAD-related SCA mostly occurs in symptomatic patients with chronic yet unrecognized multivessel CAD, highlighting its potentially predictable and preventable character and the need for improving public education.

ARTICLE INFORMATION

Data sharing: The data, analytic methods, and study materials will not be made available to other researchers for purposes of reproducing the results or replicating the procedure.

The online-only Data Supplement is available with this article at https://www.ahajournals.org/journal/circ/doi/suppl/10.1161/circulationaha.118.034664.

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Disclosures

None.

APPENDIX

Paris-SDEC Investigators

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