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Original Article

Anomalous origin of the right coronary artery from the left coronary sinus with an intramural course: comparison between sudden-death and non-sudden-death cases

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ABSTRACT

Background: The prognosis of patients in whom the right coronary artery (RCA) arises from the left coronary sinus (LCS) is unequal. An initial intramural course of the coronary artery within the aortic media is considered to cause myocardial ischemia in cases of coronary anomalies.
Methods: Clinicopathological findings in five autopsy cases where the RCA arose from the LCS with an intramural course were examined. Comparison between sudden cardiac death and noncardiac death was also performed.
Results: Two of five cases were sudden cardiac death, and the other three cases were noncardiac death. In one case of sudden death, the person collapsed during light exercise, and in the other case, the person was under the effect of methamphetamine. Both of the cases of sudden death showed an RCA-dominant pattern in distribution of the coronary artery, atherosclerotic narrowing of the RCA, and acute ischemic necrosis in the posterior basilar ventricular septum around the atrioventricular conduction system, which is considered to be the territory of the RCA.
Conclusions: An intramural course within the aortic media may be an accelerating factor of decreased blood flow in cases with an origin of the RCA arising from the LCS because of compression from the aortic lumen. However, this finding may not be an independent predictor of pathological ischemia. Additional factors that diminish blood flow in the intramural segment may be required to cause significant myocardial ischemia. Additionally, inciting factors, which can increase blood pressure, may also play a role in causing symptomatic myocardial ischemia by initiating mechanical compression from the aorta to the intramural segment of the RCA.

1. Introduction

An anomalous origin of the right coronary artery (RCA) from the left coronary sinus (LCS) has a relatively high incidence among all coronary anomalies as shown by angiographic [1–3] and autopsy studies [4]. Taylor et al. examined 242 autopsy cases of coronary anomalies and found that there were 52 (20.4%) cases of an anomalous origin of the RCA from the LCS, with sudden death occurring in 13 of 52 (25%) cases [4]. This anomaly was considered to be a minor anomaly of no clinical significance in initial reports [5,6]. However, some authors have indicated that this anomaly is susceptible to ischemia and carries a risk of sudden death. They estimate that additional morphological variants of the coronary artery may decrease blood flow in anomalous coronary arteries in cases of the RCA from the LCS [4,7–10]. In these morphological variants, an intramural course in the proximal region of the coronary artery in the wall of the aorta may be unusual. One of the coexisting findings could cause an increase in myocardial ischemia [11], similar to an intraarterial course between the aorta and pulmonary artery [7], a slit-like ostium [8], acute angle takeoff, and an ostial valve-like ridge [12].

This report describes details of anatomical and pathological findings of five cases of an anomalous origin of the RCA from the LCS with an intramural course in the aorta as a common feature. In addition, we compared findings between sudden cardiac death cases and incidentally observed cases. We also discuss the significance of these morphological changes and the pathogenesis of sudden death of such anomalies.

2. Materials and methods

We reviewed the clinicopathological records of five cases of an anomalous origin of the RCA from the LCS with an intramural course, which was found at autopsy. Sudden death was defined as unexpected death occurring within 6 h from initial symptoms as a result of natural causes [9]. Sudden cardiac death was determined by a complete autopsy examination to exclude other possible causes of death, a toxicological examination, and an investigation of the scene of death. The clinical

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Table 1
Clinical and pathological summary of the cases of anomalous RCA with intramural course

	Age	Sex	HT	Cause of death	HW (g)	Ao diameter (cm)	Dominant CA	Intramural course (cm)	Other coronary findings	Pathology of myocardium
Case 1	75	M	(+)	SCD, Coronary anomaly (during walking)	438	2.5	Right	1.2	Slit-like Os, 75% stenosis of RCA	Contraction band necrosis, moderate fibrosis
Case 2	32	M	(−)	SCD, coronary anomaly (under effect of MMP)	300	2.5	Right	0.6	50% stenosis of RCA, stenosis of AV node artery	Contraction band necrosis, moderate fibrosis
Case 3	22	M	(−)	Fire death	320	1.6	Right	0.6	Slit-like Os	None
Case 4	45	M	(−)	Drowning (suicide)	350	1.8	Balance	1.0	Slit-like Os	Mild fibrosis
Case 5	72	M	(−)	Gastric cancer, pneumonia	400	2.0	Left	1.0	Slit-like Os	Moderate fibrosis

HT, hypertension; HW, heart weight; Ao, aorta; CA, coronary artery; SCD, sudden cardiac death; Os, ostium; MMP, methamphetamine.

record of the victims was obtained from the family, and records of police examinations were collected. The ethical committee of Toyama University approved this study, which proceeded in accordance with the ethical standards established in the 1964 Declaration of Helsinki.

The hearts of these five cases were examined in a similar manner as described in our previous report [13]. The heart was excised and dissected free from the great vessels. After removing the blood in the heart, the weight of the heart, including the coronary arteries and epicardial fat, was measured to the nearest gram. The anatomy of the four major epicardial coronary arteries was examined for the type of dominance [i.e., origin of the posterior descending coronary artery from the RCA (right dominance), from the left circumflex artery (left

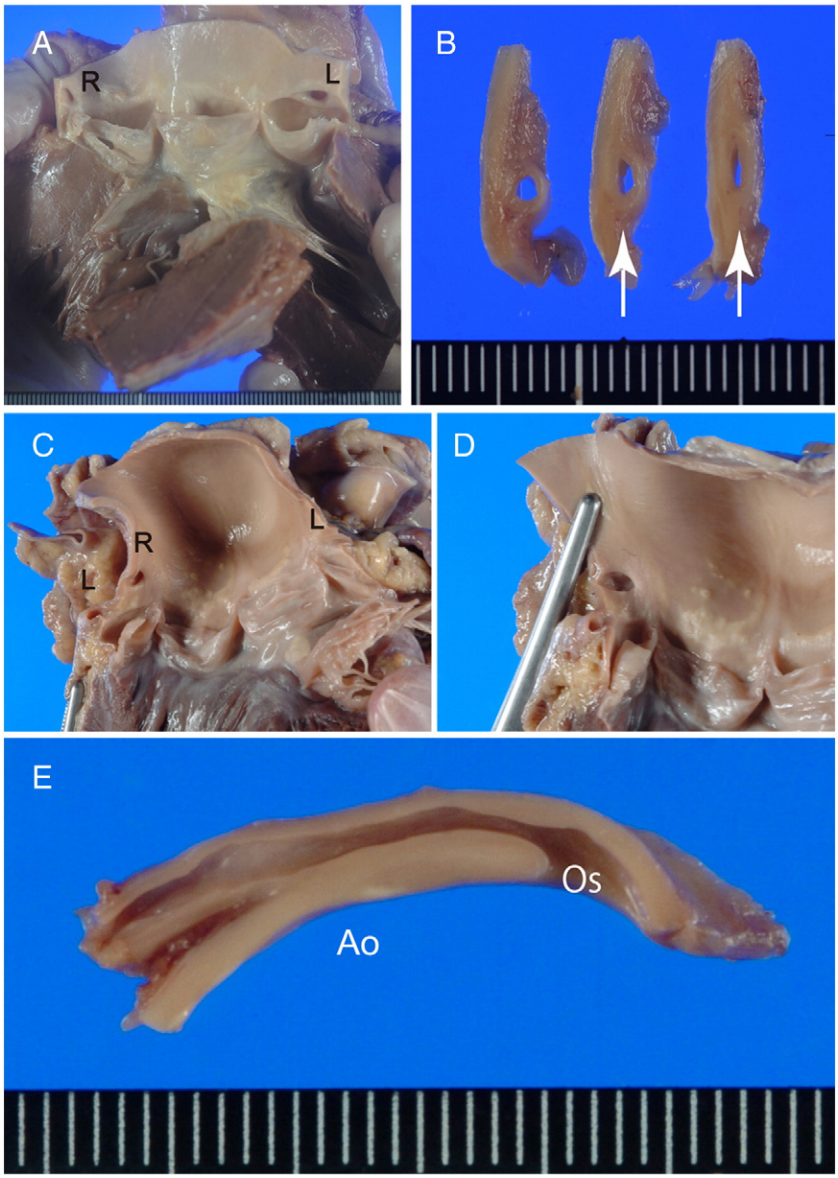

Fig. 1. Gross appearance of the coronary artery in Cases 1 (A, B) and 2 (C, D, and E). (A) The ostium of the RCA (R) is located in the LCS and shows a slit-like appearance. L, ostium of the left main coronary artery. (B) Vertical section of the proximal RCA with an intramural course (arrow). (C, D) Anomalous origin of the RCA (R) from the LCS. R, ostium of the RCA; L, left main coronary artery. (E) Horizontal section of the proximal RCA shows an intramural segment. Ao, aortic lumen, Os; ostium.