Clinical Investigations

Coronary Angiography of Cardiac Myxoma

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Summary

Background: Myxoma usually presents with nonspecific symptoms. Preoperative coronary angiography is presently only considered if patients are at increased risk of coronary artery disease (CAD). The angiographic patterns of cardiac myxoma have not been fully described.

Hypothesis: The aim of our study was to investigate coronary angiograms as well as patterns of tumor vascularity in patients with cardiac myxoma.

Methods: From January 1990 to December 2003, 33 patients with cardiac myxoma, who had received surgical resection at our hospital, were enrolled; of these, 9 patients underwent preoperative coronary angiography. The severity and extent of coronary artery stenosis, as well as tumor angiographic patterns, were analyzed. Coronary artery disease is defined as a > 50% stenosis in diameter at any segment of the coronary artery viewed by two orthogonal views on cineangiogram.

Results: Four (44.4%) patients showed concomitant CAD. The presence of coronary risk factors was not different between patients with and without CAD. Contrast media-enhanced tumor vasculature was found in five (55.6%) patients. Four (80%) patients had multiple feeding arteries. There was the characteristic “sea anemone” appearance of the tumor vasculature composed of (1) basal vascular network, (2) vessel stem, (3) backbone branches, and (4) dye brushes. These findings were characteristic of cardiac myxoma.

Conclusion: Coronary angiography can detect the concomitant coronary disease and the unique vascular appearances of cardiac myxoma. Familiarity with the “sea-anemone” angiographic findings may help in the diagnosis of cardiac myxoma.

Key words: coronary angiography, coronary artery disease, cardiac myxoma, tumor vascularity

Introduction

With the aid of two-dimensional and Doppler echocardiography, in addition to a high level of suspicion, making an accurate diagnosis of cardiac myxoma is now possible. However, opinions regarding the need of preoperative coronary angiography (CAG) for patients with cardiac myxoma remain equivocal, and the commonly accepted indication is to investigate concomitant coronary artery disease (CAD). Reasons against preoperative CAG are (1) possible procedure-related complications, (2) potential risk of sudden death from myxoma itself, and (3) lack of characteristic tumor vascularity valuable for differential diagnosis.¹ The aim of our study was to investigate coronary angiograms as well as patterns of tumor vascularity in patients with cardiac myxoma.

Methods

Patients

From January 1990 to December 2003, 33 (16 men, mean age 58 years) patients with cardiac myxoma who had received surgical resection at our institute were enrolled in the study. Based on the decisions of their respective physicians, nine (27.2%) patients (six men, mean age 67 years) underwent CAG preoperatively.

Cineangiograms

Using standard Judkin's technique, CAG was performed in these nine patients via the right femoral artery approach in both left and right coronary arteries. Cineangiograms were continued until the contrast medium was washed out after the

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venous phase. Coronary artery disease is defined as >50% stenosis in any segment of the coronary artery by two orthogonal views on cineangiogram.

Tumor vascularity was defined as abnormal clusters of small and tortuous vessels arising from the coronary artery. The characteristic appearances of tumor vascularity and the severity of CAD were reviewed. Correlation between coronary angiographic results and clinical presentations was analyzed.

Statistical Analysis

Continuous variables are expressed as mean $\pm$ standard deviation. The Student's *t*-test was used to compare continuous variables. Categorical data were analyzed by chi-square and Fisher's exact tests. A *p* value <0.05 was considered statistically significant.

Results

Patient Characteristics

The study included 17 women (52%, median age 58; range 24–81 years) and 16 men (48%, median age 58; range 24–77 years). Comorbid illness included hypertension (8/33, 24%), atrial fibrillation (4/33, 12.2%), type 2 diabetes mellitus (3/33, 9%), and previous cerebrovascular accident (2/33, 3%). Presenting symptoms were all nonspecific. Dyspnea, palpitation, chest oppression, and constitutional discomfort were frequently encountered. Only one (3%) patient was asymptomatic. At admission, congestive heart failure was shown in 19 (54.5%), possible myxoma-related systemic embolization in 8 (34%), transient ischemic attack in 7 (21.2%), pneumonia or shock in 3 (9.1%), and myocardial infarction in 2 (6.1%) patients. The average white blood cell count was 8,955 cumm (range

3,800–24,500), hemoglobin was 12 mg/dl (range 9–15), platelet count was 267,625 cumm (113,000–436,000), and the average serum lactate dehydrogenase was 228.5 mg/dl (range 120–868).

The performance of CAG in the nine patients in our series was based on the decisions of their respective physicians. Except for age (66.9 ± 8.9 vs. 56.7 ± 12.9 years, $p = 0.027$) and acute myocardial infarction (2 patients) (22 vs. 0%, $p = 0.03$), the presenting symptoms and prevalence of coronary risks, including diabetes, hypertension, smoking, family history of CAD, and dyslipidemia, were similar between those who did and did not receive CAG ($p > 0.05$).

Coronary Angiography Findings

Among our nine patients who had received preoperative CAG (6 men, age 68 ± 8 years), CAD was demonstrated in four (44%) (Table I). There was no significant difference in the prevalence of coronary risk factors (age, gender, hypertension, type 2 diabetes, smoking, or dyslipidemia), presenting symptoms, or electrocardiographic evidence of ischemia between the patients with and without CAD. There was no calcified spot on the myxoma on cineangiogram.

Of these nine patients, obvious tumor vascularity and feeding arteries arising from the coronary artery were present in five (55.6%) (Patients No. 1 to 5). Tumor vascularity and feeding arteries were seen in at least two different orthogonal views on fluoroscopy. In our series, multiple feeding arteries were usually found. Two patients had three feeding vessels, two patients had two, and only one patient had a single feeding vessel. The sinoatrial (SA) nodal branch of the right coronary artery (RCA) (5/5, 100%) was the most common feeding artery encountered, followed by the atrioventricular (AV) nodal branch of the RCA (4/5, 80%), and the atrial branch of the left circumflex coronary artery (LCx) (2/5, 40%).

TABLE I Cineangiography data of patients with myxoma

Patient No.	Sex	Age (year)	Myxoma location	Coronary risk factors	Feeding artery	CAD (stenosis)	Tumor vascularity of myxoma (y/n)					
							BVN	VS	VB	DB	ACF	C
1	F	56	LA(S)	None	SAAn + AVn + LCx	Normal	y	y	y	y	y	n
2	M	76	LA(F)	H/T; H/L; Smoker	SAAn + AVn + LCx	LAD (99%)	y	y	y	y	y	n
3	M	77	LA(S)	Smoker	SAAn + AVn	Insignificant RCA (20%)	y	y	y	y	y	n
4	M	71	LA(F)	H/T; smoker	SAAn	LAD (65%) & LCx (90%)	y	y	y	y	n	n
5	F	71	LA(S)	H/L	SAAn + AVn	Normal	y	y	y	y	n	n
6	F	52	LA(F)	None	Not seen	Normal	n	n	n	n	n	n
7	M	73	LA(F)	H/T	Not seen	LAD (90%)	n	n	n	n	n	n
8	M	63	LA(S)	None	Not seen	LCx 80%	n	n	n	n	n	n
9	M	63	LA(S)	Smoker	Not seen	Normal	n	n	n	n	n	n

Abbreviations: LA = left atrium, S = septum, F = free wall, CAD = coronary artery disease, SAAn = sinoatrial nodal artery, AVn = atrioventricular nodal artery, LAD = left anterior descending coronary artery, LCx = left circumflex artery, RCA = right coronary artery, LMb = atrial branch of left main coronary artery, BVN = basal vascular network, VS = vascular stem, BB = backbone branches, DB = dye brush, ACF = arterio-cavity fistula, C = calcification, H/T = hypertension, H/L = hyperlipidemia, y = yes, n = no.

A review of the angiographic patterns of tumor vascularity showed that vessel distribution and ways of contrast filling bore the same characteristics (Fig. 1A and B). The myxoma adhered to the left atrial septum with three feeding vessels arising from the SA and the AV nodal branches from the RCA and the atrial branch from the LCx. The feeding vessels traveled a distance and diverged into small and tortuous branches. These vessels were intertwined and formed a basal vascular network lying over the atrial wall, on which the myxoma was attached. Then, at the center of the basal vascular network, vessel branches converged and formed a short vascular stem. Later, the vessels within the vascular stem diverged again and formed the backbone branches of the tumor mass. Areas of contrast stasis or dye brush were seen over the endocardial surface of the tumor. Over these dye brush areas, an arteriocavity fistula was noted. Not only contrast enhancement, but also the dye clearance of the tumor vasculature was obviously delayed in comparison with that of normal coronary vasculature. The dye brush remained and may even have been visible when we performed the next contrast injection with a different orthogonal view. Similar to the pattern in Patient No. 1, the tumor vasculature of the myxoma in Patient No. 2 looked like a sea anemone with wide spread root, with its body waving rapidly back and forth following the water tide (Fig. 2A and B).

The basal vascular network on the atrial wall, vascular stem, backbone branches, and dye brush were present in all five patients with visible tumor vascularity. Arteriocavity fistula was present in three (60%) patients. The other four patients who had no obviously visible tumor vascularity showed only faint contrast staining within the atrium during coronary angiogra-

phy. In the nine patients who underwent CAG, the existence of tumor vascularity on angiography was not related to the diameter of the tumor mass, comorbid CAD, or biochemical profiles (all p value > 0.05).

Left ventriculogram was performed in Patients No. 2 and 3. Due to mitral regurgitation, a swinging tumor filling defect that prolapsed into the left ventricle during the diastolic phase was shown (Fig. 3A and B). There were no procedure-related complications in these nine patients.

Treatment and Outcomes

Myxoma excision was performed in all 33 patients. The four patients with CAD as shown on angiography also underwent coronary artery bypass surgery. There was no recurrence during follow-up by clinical examination and echocardiography. One patient died of ovarian cancer 3 years after myxoma excision without evidence of myxoma recurrence.

Discussion

The clinical significance of preoperative CAG for myxoma remains equivocal. Concomitant CAD was shown in four (44%) patients in our series. Previous studies showed a prevalence rate of 0–66.7%.^{2–5} Li *et al.* analyzed a series of 24 cases and found no correlation between CAD and the acknowledged coronary risk in their study.⁴ In the present study, there was also no difference in coronary risk factors between patients with and without CAD. Tumor emboli or cytokine-related thrombosis may partially contribute to the high preva-

(A)

(B)

FIG. 1 Angiographic pattern of cardiac myxoma in Patient No. 1. (A) From the left anterior oblique (LAO) caudal view, the feeding vessel (FV) arises from the LCx. The FV traveled a distance and formed a basal vascular network (BVN) lying over the atrial wall to which the myxoma adhered. At the center of the BVN, vessel branches converged and formed a short vascular stem (VS). The vessels within the VS diverged again and formed the backbone branches (BB) of the tumor mass. Areas of contrast stasis or dye brush (DB) are seen over the top surface of the tumor lobe. Over these DB areas, an arterio-cavity fistula (ACF) can be seen. (B) Seeing the myxoma from LAO view. Right coronary angiography showed that both atrioventricular nodal and sinoatrial nodal arteries provide the feeding vessel supplying the myxoma.

FIG. 2 Angiographic pattern of myxoma in Patient No. 2. (A) From the left anterior oblique (LAO) view, myxoma tumor vascularity was visible under right coronary angiography. (B) The vasculature of the myxoma looks like a sea anemone with wide spread root, with its body waving furiously forth and back following the water tide. RCA = right coronary artery. Other abbreviations as in Figure 1.

lence rate of CAD in patients with myxoma.^{6,7} In two of our patients (Nos. 3 and 7) with acute myocardial infarction, myxomas were found incidentally by echocardiography. Subsequent CAG after thrombolytic therapy showed significant coronary artery stenosis of the infarct-related artery in Patient No. 7. However, Patient No. 3 with right ventricular infarction only showed luminal irregularity over the proximal part of RCA. Coronary embolism could not be ruled out in these two patients.

Tumor vascularity, observed in 33.3–55.6% of patients with myxoma receiving elective CAG, has long been described as

just “a mass of tortuous and dilated small vessels.”^{2,3,5} It was previously considered nonspecific, noncharacteristic, and unable to provide clues for differential diagnosis.² We found a characteristic appearance of tumor vascularity, probably unique to cardiac myxoma, in 55.6% of our patients. We named it for its “sea anemone-like” appearance due to its unique morphology on angiography, and the way it swung in the heart chambers during the cardiac cycle. By identifying the sea anemone-like appearance on angiography, it is quite easy to differentiate myxoma from isolated congenital coronary anomalies or other kinds of tumors, such as coronary fistulae,⁸

FIG. 3 Left ventriculography of Patient No. 3. From the right anterior oblique (RAO) view, due to mitral regurgitation, the left atrium was quickly opacified by contrast medium during left ventriculography. (A) A huge filling defect (arrow) representing the cardiac myxoma swinging within the left atrium was noted in the systolic phase. (B) Tumor prolapsed into left ventricle during the systolic phase. LA = left atrium, LV = left ventricle.

CAD,⁹ intracardiac thrombus,^{10,11} myocardial hemangiomas, ¹² cardiac lymphoma,¹³ cardiac fibroma,¹⁴ and various kinds of cardiac metastases.^{15,16} Abnormal clusters of vessels can be revealed in all these conditions, but the site of attachment, the characteristic vascular patterns, and the dynamic motion during the cardiac cycle are quite different from those presented in the sea anemone appearance. In addition, detailed analysis of tumor vascularity may disclose an unrecognized tumor mass in patients with multiple tumor lesions as well as the actual territory of cardiac myxoma. In cases presenting with myocardial infarction, myxoma may be found incidentally by routine CAG.

Although two of our patients underwent left ventriculography, the tumor filling defect and hyperdynamic movement were visible due to the regurgitant mitral flow. However, this procedure may still be risky due to frequent tumor prolapse into the left ventricle. By observing the levophase of the right ventriculogram for left-side cardiac myxoma, the risk may be reduced.

Preoperative CAG is quite safe. Thus far there has been no report of procedure-related complication.²⁻⁵ For patients with myxoma, preoperative CAG should be considered, especially in those with increased risk of CAD.

Study Limitations

This is a retrospective study, and we are unaware of the actual reasons some patients in our series received coronary angiography and others did not. No myxoma was located in either the right or left ventricle of the patients enrolled in our study; therefore we are unable to conclude that all cardiac myxomas bear the same angiographic characteristics.

Conclusion

Coronary angiography can detect concomitant coronary disease and the unique sea anemone-like vascular appearance

in a significant number of patients with cardiac myxoma. This should be considered in the evaluation of patients with cardiac myxoma, especially in aged patients.

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