Fig. 1. Posteroanterior chest x-ray film showing a well-circumscribed lesion filling the left hemithorax.

operations, but none of our patients had undergone such operations. The apparent association of thymic cysts with infection (e.g., syphilis or tuberculosis) has been reported² but was not present in our cases. If hemorrhage occurs, fluid in the cyst becomes brownish and more viscid. In two of our patients, the cysts had such findings. Microscopic examination did not show a definite epithelium. The walls showed fibrocollagenous scar tissue formation. Malignant degeneration, although rare, has been reported⁵ but was not seen in this review. Some malignant tumors, particularly thymoma, Hodgkin's disease, and seminoma, can show prominent cystic changes. We therefore made every

effort to detect any malignant tissue on pathologic examination. A diffuse goiter was seen in three of five patients. However, this finding may be coincidental because goiter is endemic in Turkey. This relationship should be investigated further. Operative excision of thymic cysts seems both diagnostic and curative.

Except in case 1, the thymic cysts were not localized in the midline and all were large. Therefore we preferred thoracotomies to explore and excise the cysts rather than median sternotomies. The cysts were completely removed to prevent a recurrence and to eliminate the risk of malignant transformation. Thoracotomy in patients with large cysts allows for easy removal of the cysts. Neither aspiration nor decompression of the cysts was necessary.

REFERENCES

1. Suster S, Rosai J. Multilocular thymic cyst: an acquired reactive process—study of 18 cases. *Am J Surg Pathol* 1991;15:388-98.
2. Bieger RC, McAdams AJ. Thymic cysts. *Arch Pathol* 1966;82:535-41.
3. Dunne MG, Weksberg AP. Thymic cyst: computed tomography and ultrasound correlation. *J Comput Tomogr* 1983;7:351-5.
4. Shapiro J, Gallant A, Wechsler RJ, Steiner RM. Thymic cyst secondary to cervical irradiation: a complication of treated laryngeal cancer. *Comp Med Imaging Graph* 1991;5:319-22.
5. Leon AS-Y, Brown JH. Malign transformation in a thymic cyst. *Am J Surg Pathol* 1984;8:471.

CORONARY ARTERIES ARISING FROM THE CONTRALATERAL AORTIC SINUS: ELECTRON BEAM COMPUTED TOMOGRAPHIC DEMONSTRATION OF THE INITIAL COURSE OF THE ARTERY WITH RESPECT TO THE AORTA AND THE RIGHT VENTRICULAR OUTFLOW TRACT

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The variations in the initial course of a coronary artery with an abnormal origin are more important than the abnormal origin itself. Certain of these variations are associated with sudden death, myocardial infarction, or angina pectoris when the left main coronary artery or the right coronary artery passes between the aorta and the pulmonary trunk.¹ The relationship between the initial course of the aberrant coronary artery and the aorta and

the right ventricular outflow tract, however, can be difficult to assess by coronary angiography. Electron beam computed tomography (EBCT) and magnetic resonance imaging have recently shown potential in the visualization of the coronary arteries.^{2, 3} This report describes six cases in which the initial courses of the left main coronary artery, originating in the right sinus of Valsalva, or the right coronary artery, originating from the left sinus, were clearly detailed with EBCT.

Case histories and EBCT results. In three cases with the left main coronary artery arising from the right aortic sinus, EBCT detected the initial course of the abnormal coronary artery with respect to the right ventricular outflow tract. The passage of the artery between the aorta and the pulmonary trunk was found in one patient admitted to intensive care for an extensive acute anterior myocardial infarction (Fig. 1). Coronary arteriography showed the left main coronary artery arising from the initial part of the right coronary artery in the second case. EBCT examination (Fig. 2) depicted the intramyocardial tunneling of the left main coronary artery within the

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Fig. 1. Electrocardiographically gated 100 msec axial EBCT images after enhancement at four levels from top (A) to bottom (D). Both exact origin of left main coronary artery (*arrow*) from right sinus of Valsalva and its passage between ascending aorta (*AA*) and pulmonary artery (*PA*) are shown in A and B. Division of left coronary artery into left anterior descending and circumflex arteries behind pulmonary artery is depicted in B, C, and D.

Fig. 2. Electrocardiographically gated 100 msec axial EBCT images after enhancement at four levels from top (A) to bottom (D). Left coronary artery arises from initial part of right coronary artery (*arrow*) in B, C, and D. Its intramyocardial course crossing upper part of interventricular septum is shown in C and D (*open arrow*). A also shows calcified left anterior descending artery and circumflex artery lying within anterior interventricular groove.

Fig. 3. Two native electrocardiographically gated 100 msec axial EBCT images after enhancement at two levels in **A** and **B**. **C**, Three-dimensional surface-shaded image. **D**, Selective right coronary arteriography viewed in left anterior oblique projection. Origin of left coronary artery (*black arrow*) from right coronary artery (*white arrow*) in right sinus of Valsalva is seen in **A** and **B**. Initial course of left coronary artery in front of pulmonary artery (*PA*) is shown in **C** and **D**; it then divides into left anterior descending artery (*white arrowheads*) and circumflex artery (*black arrowheads*). *AA*, Ascending aorta.

septum before its bifurcation into the left anterior descending and circumflex arteries. In the third patient with an extremely abnormal left ventricular compliance (Fig. 3), the course between the pulmonary artery and the ascending aorta could not be formally ruled out by conventional coronary arteriography. The passage of the left main coronary artery well in front of the pulmonary trunk was clearly detected by EBCT. EBCT confirmed the right coronary artery's origin in the left aortic sinus and detected the passage of the artery between the pulmonary artery and the aorta in three other cases (Fig. 4).

Discussion. This report illustrates the utility of EBCT in determining the exact origin of the left main coronary

artery from the right sinus of Valsalva, or the right coronary artery from the left sinus of Valsalva. Above all, it shows that this method is accurate for evaluating the initial course of the abnormal coronary artery with respect to the right ventricular outflow tract. The passage of the artery between the aorta and the pulmonary trunk, considered an important risk factor for infarction or sudden death, can be diagnosed by this means. When the left main coronary artery arises from the right aortic sinus or the right coronary artery arises from the left sinus, it can be difficult to determine angiographically whether the aberrant vessel passes in front of the right ventricular outflow tract or behind it, between the outflow tract and the aorta.

Fig. 4. Electrocardiographically gated 100 msec axial EBCT images after enhancement. Both coronary origins are detected on left aortic sinus, and the passage of right coronary artery (*arrow*) is detected between ascending aorta (*AA*) and pulmonary artery (*PA*).

In our experience, the best way to determine this has been to pass a catheter into the main pulmonary artery and then perform an arteriogram of the aberrant coronary artery in the direct lateral projection. The catheter locates the pulmonary artery, and it is then usually possible to determine whether the coronary artery runs anterior or posterior to the outflow tract. Invasive procedures during coronary arteriography can be avoided, however, if EBCT is employed after conventional arteriography.

Selective coronary angiograms may also be difficult when the origin of the coronary artery is abnormal. This was the case in two patients in our study in whom the right coronary artery arose from the left sinus of Valsalva. EBCT was nevertheless able to detect the abnormal origin of the right coronary artery in these patients and show that it ran between the pulmonary artery and the aorta. The intramyocardial tunneling illustrated in Fig. 2 is the second important variation in course of the left coronary artery arising from either the aorta or the common coronary artery that can be recognized by EBCT. Detection of such variation can alter management, because the absence of evidence of myocardial ischemia, both clinically and at autopsy in reported cases, suggests that tunneling is unlikely to cause myocardial ischemia.⁴

EBCT is based on scanning electron beam technology that eliminates all mechanical motion except for that of the patient table. The EBCT scanner acquires complete computed tomographic scans in 50 or 100 msec, producing high-resolution images free of artifacts even in moving organs such as the heart. In this study, EBCT was therefore carried out with contiguous electrocardiographically gated 100 msec scans during breath holding and

delivery of an injection of 100 ml contrast medium. A distance between sections of 3 mm or less ensures that the initial few centimeters of the coronary arteries and their relationship with the neighboring structures at the base of the heart can be visualized. The minimum section thickness with the new systems of EBCT is 1.5 mm, and this should allow better three-dimensional representation of coronary arteries.³ Morphologic EBCT analysis was carried out on the native sections and after three-dimensional reconstruction and surface-shaded representation, such as in Fig. 3 (C).

EBCT was initially developed for the noninvasive quantification of coronary calcium,⁵ but these new systems of both acquisition and representation may well make it capable of detecting atheromatous coronary stenoses by the injection of contrast material.³ Charges for heart EBCT examination with intravenous contrast medium in the United States currently range from \$600 to \$800. The diagnosis of coronary stenosis by tomographic methods has already been shown to be feasible with magnetic resonance angiography without the need for contrast material and ionizing radiation. Both spatial resolution and coronary artery enhancement, however, are still less than those obtained by EBCT during breath holding.

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REFERENCES

1. Roberts W. Major anomalies of coronary arterial origin seen in adulthood. *Am Heart J* 1986;111:941-63.
2. Manning WJ, Li W, Boyle NG, Edelman RR. Fat-suppressed

- breath-hold magnetic resonance coronary angiography. *Circulation* 1993;87:94-104.
3. Moshage WE, Achenbach S, Seese B, Bachmann K, Kirchengorg M. Coronary artery stenoses: three-dimensional imaging with electrocardiographically triggered, contrast agent-enhanced, electron-beam CT. *Radiology* 1995;196:707-14.
 4. Roberts W, Diccio B, Waller B, Kishel J, McManus B, Dawson S, et al. Origin of the left main from the right coronary artery or from the right sinus with intramyocardial tunneling to the left side: the case against clinical significance of myocardial bridge or coronary tunnel. *Am Heart J* 1982;104:303-5.
 5. Fallavollita JA, Brody AS, Bunnell IL, Kumar K, Canty JM. Fast computed tomography detection of coronary calcification in the diagnosis of coronary artery disease. *Circulation* 1994;89:285-90.

SALMONELLA PROSTHETIC VALVE ENDOCARDITIS

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Salmonella endocarditis has been characterized by its destructive process and malignant clinical course.¹ Although an increasing number of such infections have been evident in recent years, *Salmonella* prosthetic valve endocarditis (PVE) is still rare.²⁻⁴ Only seven case reports have appeared in the English literature up to now. Because of its rarity and unusual clinical course, we describe the eighth case of *Salmonella* PVE in a patient who underwent rereplacement of the aortic and mitral prosthetic valves and simultaneous cholecystectomy. We also review the previous cases reported in the literature.

Case report. A 58-year-old man was admitted on an emergency basis on October 1, 1994, with fever, chills, and weakness of 3 days' duration. He had undergone aortic and mitral replacement, tricuspid annuloplasty, and closure of an atrial septal defect in 1981 at 45 years of age. He had two brothers who had died of enteric typhus. On admission, his temperature was 42.0° C and blood pressure was 86/60 mm Hg. He had normal regular prosthetic valve sounds at 76 beats/min. The white blood cell count was 12,100/mm³ with 61% segmented polymorphonuclear white cells and bands of 15% but with no eosinophils. The chest x-ray film showed moderate cardiomegaly and the electrocardiogram showed incomplete right bundle branch block with normal sinus rhythm. After intravenous antibiotics were given, the white blood cell count decreased, the eosinophil count increased, and spiking fevers disappeared. Because clinical examinations showed

no evidence of infectious endocarditis, antibiotics were discontinued on day 28 after admission. Five days later, his body temperature elevated again with chills. The white blood cell count increased and the eosinophil count decreased. *Salmonella typhimurium* was isolated from the blood three times after recurrent fever. A transesophageal echocardiogram (TEE) revealed a highly mobile echo mass attached to the anulus of the mitral prosthetic valve and an immobile echo mass on the subvalvular position of the aortic valve.

After 66 days of hospitalization, he underwent rereplacement of the aortic and mitral prosthetic valves and simultaneous cholecystectomy. The aortic prosthetic valve did not appear grossly infected but had moderate sized subvalvular pannus formation. A vegetation was found on the anterior anulus of the mitral valve. The mitral and aortic prostheses were replaced with a CarboMedics bileaflet prosthesis (29 mm in diameter; CarboMedics, Inc., Austin, Tex.) and a St. Jude Medical prosthesis (25 mm in diameter; St. Jude Medical, Inc., St. Paul, Minn.). After closure of the chest, the gallbladder was removed in the usual fashion. Gall stones were found in the gallbladder, but intraoperative cholecystography revealed no choledochal stones. The patient was moved to the intensive care unit in a stable hemodynamic condition. Microscopic examination of the tissue surrounding the mitral prosthetic valve showed diffuse infiltration of lymphocytes and neutrophils with clusters of micrococci. The gallbladder showed mild cellular infiltration. Culture of the vegetation and bile grew *Micrococcus* but no *Salmonella*. The concentrations of sulbactam and cefoperazone in the serum, the wall of the gallbladder, and the bile in the gallbladder were four times higher than the minimum inhibitory or bactericidal concentration for *S. typhimurium*, resulting in a failure to isolate *Salmonella* from these specimens. Imipenem, to which not only *Salmonella* but *Micrococcus* was sensitive, was given intravenously for 6 weeks after the operation. A TEE on postoperative day 35 revealed no vegetation, and he was discharged on postoperative day 36. He had no evidence of recurrent infection during 1 year of follow-up.

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