Evaluation of the Coronary Arteries

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The following points should be considered when evaluating the coronary arteries:

1. The origin, number, course, and termination of the coronary arteries should be evaluated. The surgeon should be notified prior to surgery of an anomalous course of the coronaries, especially if it crosses anterior to an outflow tract.
2. The coronary artery rarely may arise from the pulmonary artery, such as in anomalous left coronary artery from the pulmonary artery (ALCAPA).
3. An increased caliber of the coronary arteries in a newborn may suggest a fistulous communication with a low-pressure system, such as the right ventricle, atrium or pulmonary artery.

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Normal Coronary Artery Anatomy

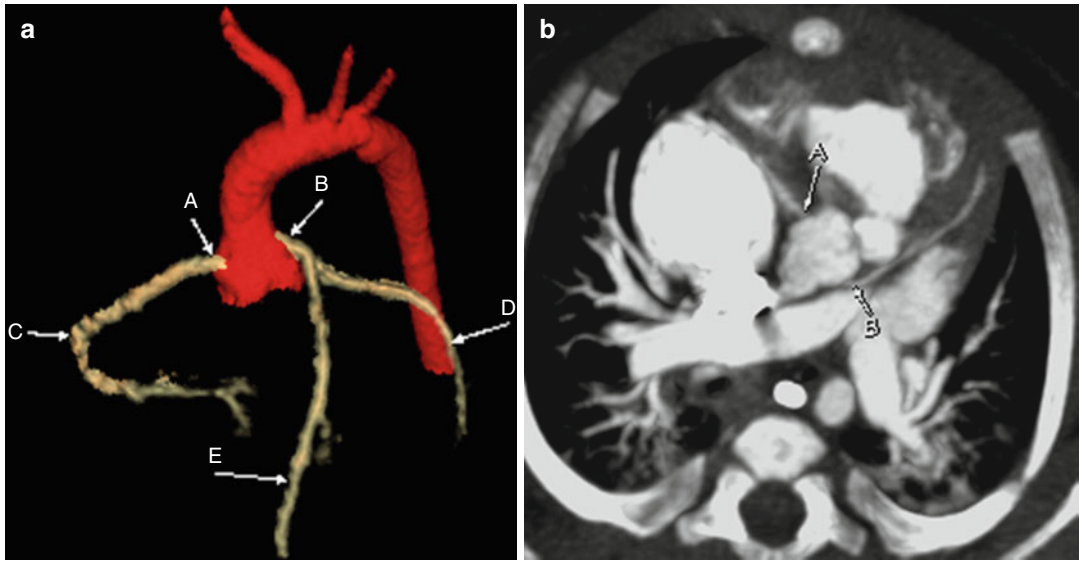

Fig. 8.1 Color-coded three-dimensional (3D; **a**) and axial maximum-intensity projection (MIP; **b**) images from a patient with normal anatomy. The right coronary artery (*C*) arises normally from the right coronary sinus (*A*). The left coronary artery (*B*) arises normally from the left coronary sinus. The left coronary artery divides into the circumflex artery (*D*) and the left anterior descending coronary artery (LAD; *E*)

ALCAPA

ALCAPA (anomalous left coronary artery from the pulmonary artery) is a coronary artery anomaly in which the left coronary artery arises from the pulmonary artery. It leads to cardiac ischemia and infarction, poor left ventricular function, and mitral valve regurgitation. The ischemia typically is a result of a steal phenomenon as the blood is shunted away from the heart to the low-pressure pulmonary artery system through the anomalous coronary artery. Patients with ALCAPA present in infancy with nonspecific symptoms, such as irritability, wheezing, and failure to thrive. The diagnosis usually is made by echocardiography, although cardiac CTA may be used in difficult

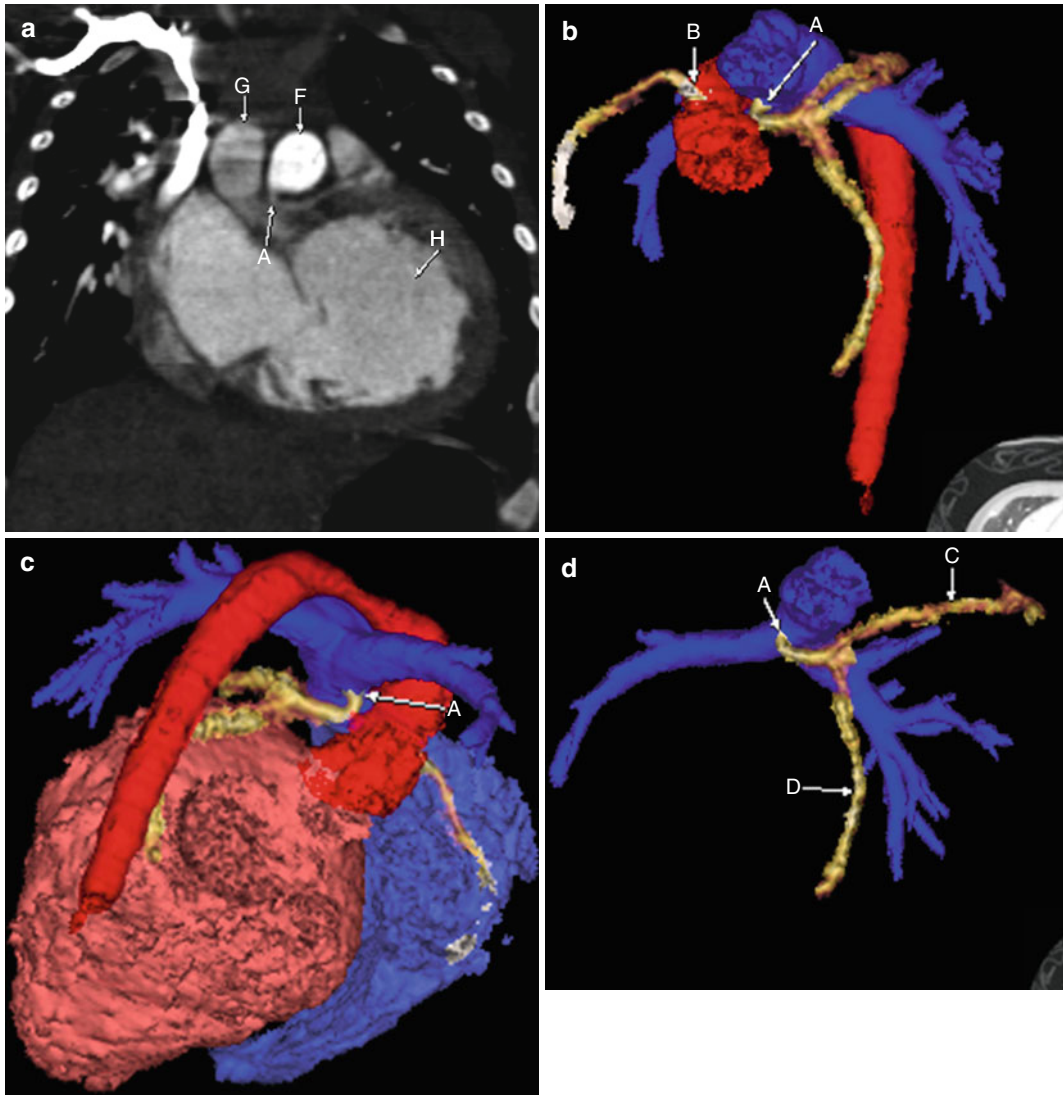

Fig. 8.2 Coronal MIP image (**a**) and color-coded 3D reconstructions (**b**–**d**) showing the left coronary artery (*A*) arising from the pulmonary artery (*F*, *blue*). The left coronary then branches normally into the LAD (*C*) and circumflex (*D*) arteries. The right coronary artery (*B*) is noted to originate normally from the aorta (*G*, *red*). Notice the dilated left ventricle (*H*)

cases. Findings consist of decreased left ventricular function, an anomalous origin of the coronary artery, and potentially enlarged collateral vessels. ALCAPA may be an isolated finding or may occur with other congenital heart anomalies. Surgical treatment involves either direct transfer of the left coronary artery to the aorta or bypass grafting.

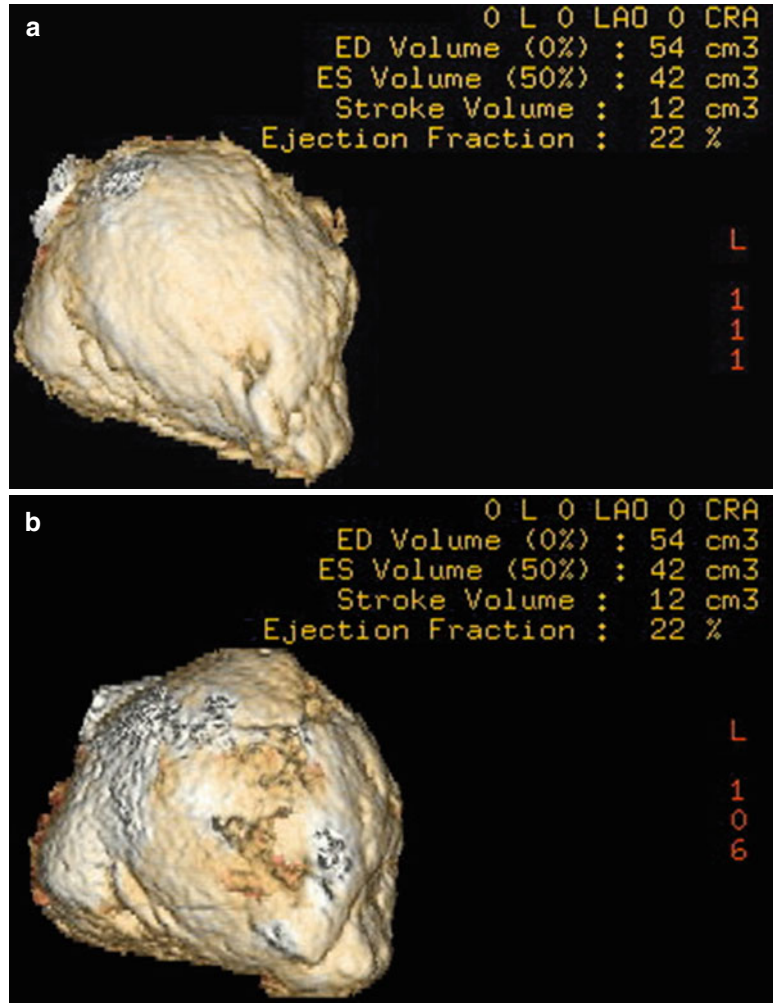

Fig. 8.3 End-systolic (**a**) and end-diastolic (**b**) images from volumetric analysis in a patient with ALCAPA showing a markedly decreased ejection fraction of 22 % and a very dilated left ventricle. The heart failure develops from a steal phenomenon as flow in the anomalous left coronary flows toward the low-pressure pulmonary artery, stealing blood from the heart

Anomalous Right Coronary Artery from the Pulmonary Artery

Anomalous right coronary artery from the pulmonary artery (ARCAPA) is a rare coronary artery origin anomaly in which the right coronary artery arises from the pulmonary artery. As in ALCAPA, patients may present with a variety of nonspecific signs and symptoms, such as heart failure, angina, and myocardial infarction. Cardiac CTA may be used to demonstrate the anomalous origin of the artery. Coronary artery anomalies may be an isolated finding or may be associated with other anomalies. It is important to identify associated defects for surgical planning. Surgical treatment involves either direct transfer of the artery to the aorta or bypass grafting.

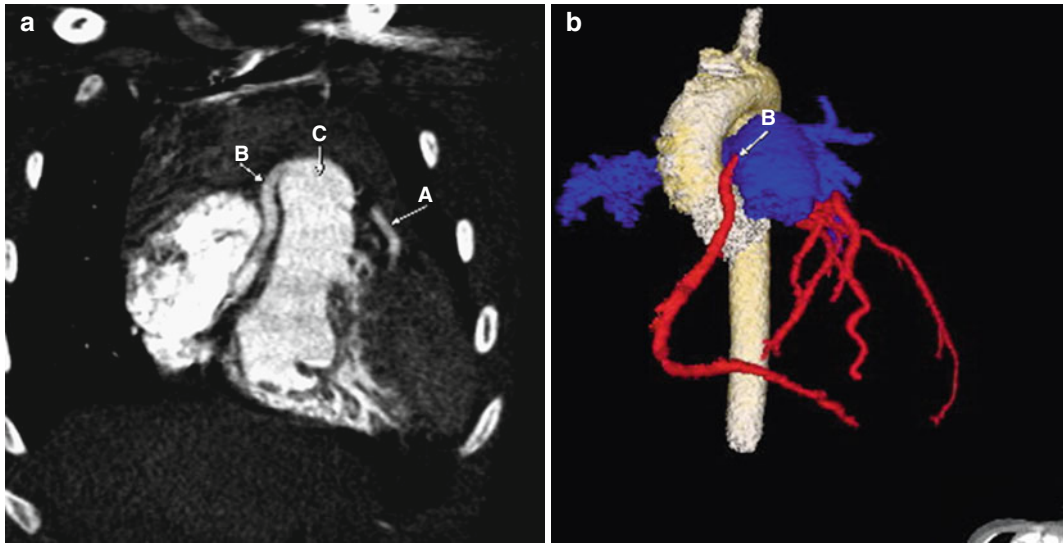

Fig. 8.4 (**a**) Coronal image from a cardiac CTA scan showing the right coronary artery (*B*) arising from the pulmonary artery (*C*). The left coronary artery (*A*), which originates normally from the aorta, also is seen. (**b**) Color-coded 3D model also showing the right coronary artery (*B*) arising from the pulmonary artery (*blue*)

Interarterial (Malignant) Left Coronary Artery

Interarterial left coronary artery is an anomaly in which the left coronary or left anterior descending artery arises from the right sinus of Valsalva (or right coronary artery) and courses between the aorta and the pulmonary artery (interarterial course). Patients are at risk for myocardial ischemia or sudden death with strenuous physical activity. The potential causes of increased morbidity and mortality include coronary artery compression or spasm, a slitlike orifice of the origin of the artery, an acute angle near the ostium, and an intramural course of the proximal artery within the aortic wall. Contrast-enhanced CT is the best imaging modality to evaluate the course of the coronary arteries. Treatment consists of coronary bypass or transfer of the coronary artery to the left sinus of Valsalva.

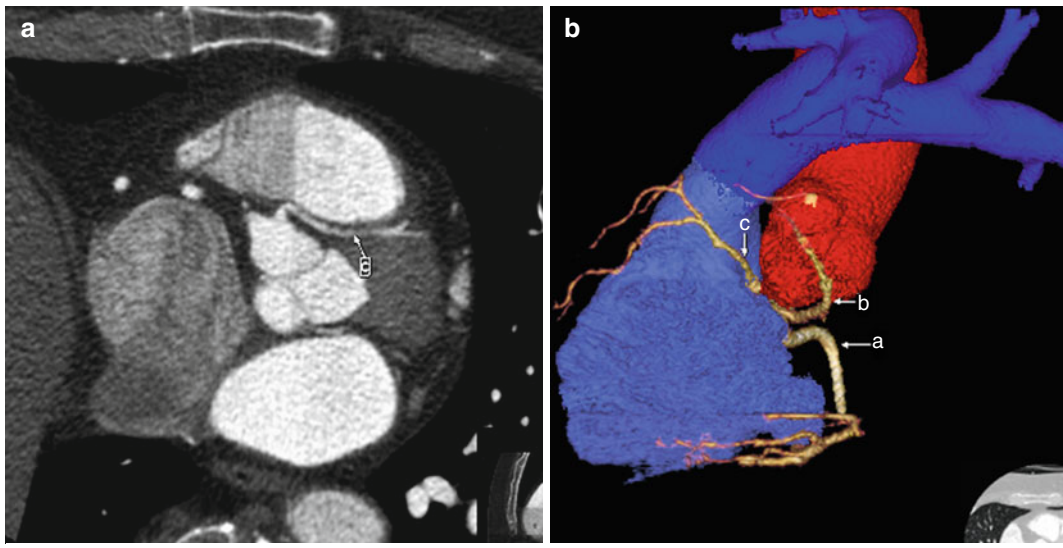

Fig. 8.5 Axial coronary (**a**) and 3D color CTA (**b**) images showing the left anterior descending coronary artery (*c*) arising from the right sinus of Valsalva with an interarterial course between the aorta (*red*) and pulmonary artery (*blue*). The circumflex (*b*) is anomalous, taking a circumaortic course, and arises from the right coronary artery (*a*)

Interarterial (Malignant) Right Coronary Artery

Interarterial right coronary artery is an anomaly in which the right coronary artery arises from the left sinus of Valsalva and courses between the aorta and pulmonary artery. The right coronary artery also may arise from the left main coronary artery or superior to the sinotubular junction. Patients are at risk for sudden death, often precipitated by exercise. The potential causes of increased morbidity and mortality include a slitlike ostium, acute angulation at the origin of the artery, and compression of the vessel between the aorta and pulmonary artery. Cardiac CTA is the best imaging modality to evaluate the coronary anatomy.

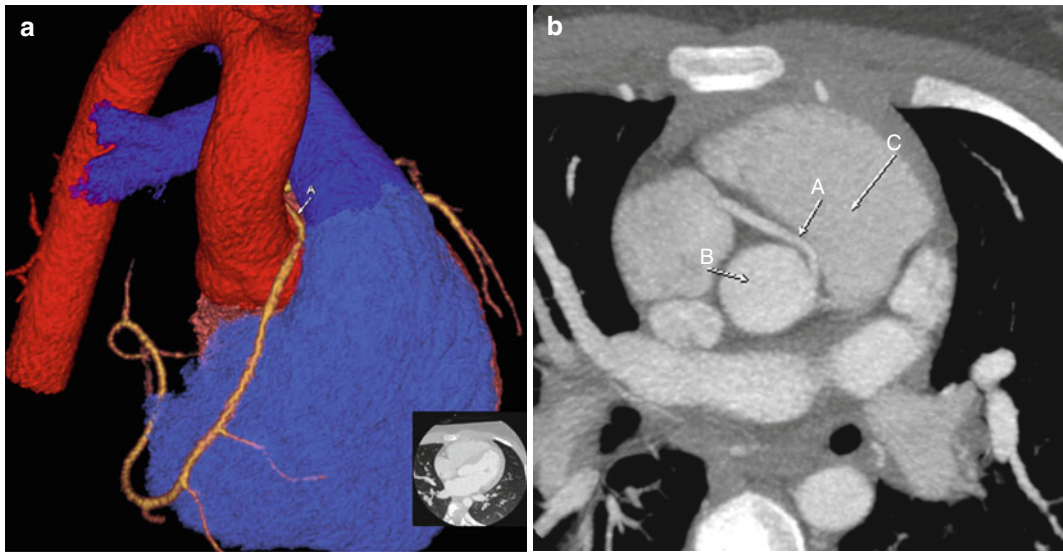

Fig. 8.6 Color-coded 3D (**a**) and axial cardiac CTA (**b**) images demonstrating the right coronary artery (**a**, *A*) arising from the left sinus of Valsalva and coursing between the aorta (*red*, *B*) and pulmonary artery (*blue*). The right ventricle (*C*) is also noted compressing the right coronary artery (*A*)

Prepulmonary Right Coronary Artery

Prepulmonary right coronary artery is an anomaly in which the right coronary artery courses anterior to the pulmonary artery. It is associated with anomalous origin of the right coronary artery, in which the right coronary artery arises from the left sinus of Valsalva or left main coronary artery. It is important to detect this anomaly and alert the surgeon so he or she can avoid severing the vessel during cardiac surgery. This is especially true for patients with tetralogy of Fallot or right ventricular outflow tract stenosis, in which the right coronary artery might be compromised.

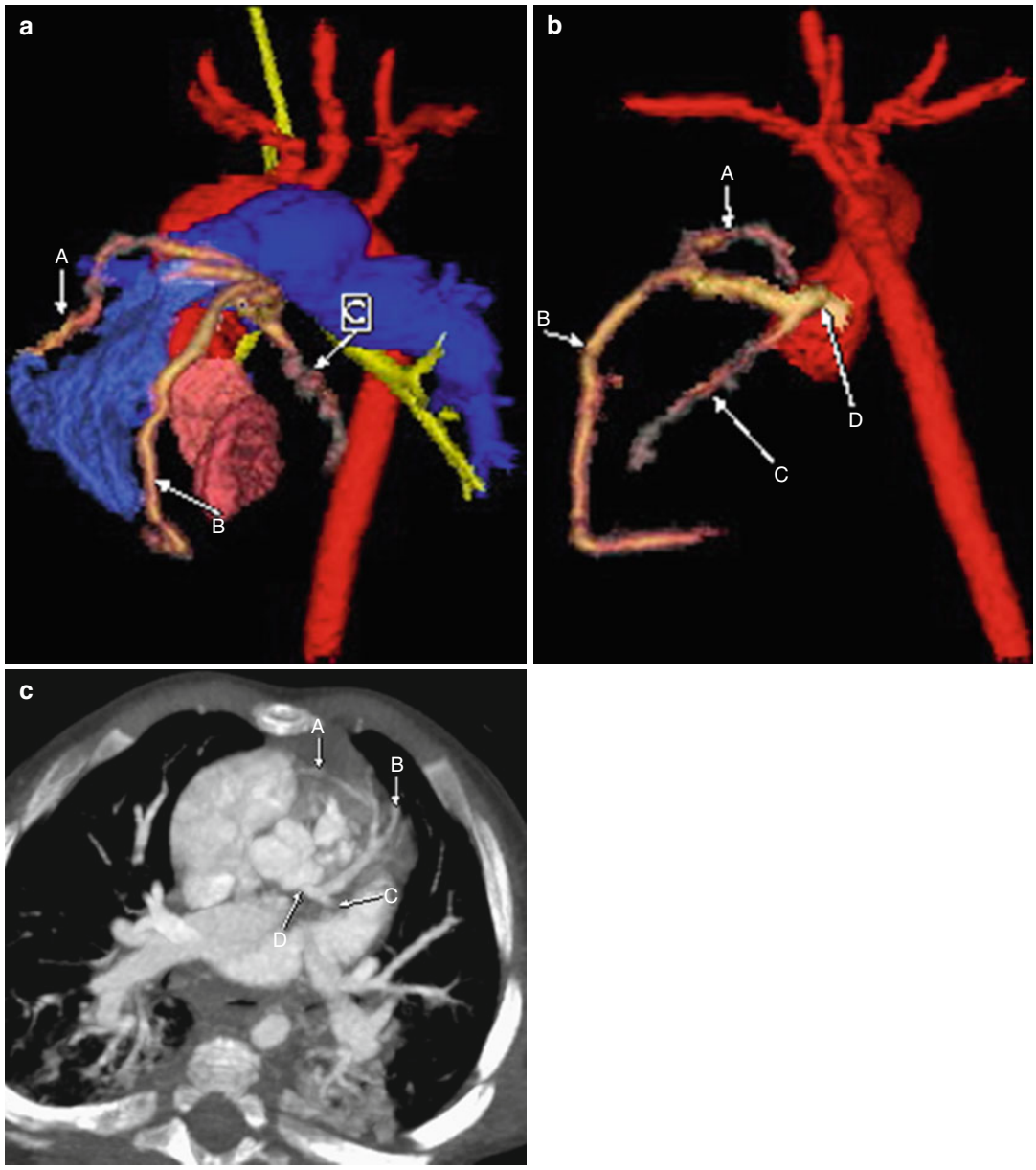

Fig. 8.7 Color-coded 3D reconstructions (**a** and **b**) and axial cardiac CTA scan (**c**) showing the right coronary artery (*A*) arising from the left main coronary artery (*D*) and coursing anterior to the pulmonary artery (*blue*). This position puts the right coronary vessel at risk of being severed during cardiac surgery if the surgeon is not aware of the finding. The left anterior descending (*B*) and left circumflex (*C*) arteries also are noted

Coronary Artery Fistulas

Coronary artery fistulas are abnormal connections between a coronary artery and either a cardiac chamber (coronary cameral fistula) or any portion of the pulmonary or systemic circulation (coronary artery fistula). The coronary artery bypasses the myocardial capillary bed to communicate directly with these structures. The vessel may connect to the pulmonary artery, coronary sinus, atria, or ventricles. Often, there are multiple feeding vessels, which may be tortuous and dilated. Most fistulas are small and cause no symptoms; however, larger fistulas may require surgical intervention.

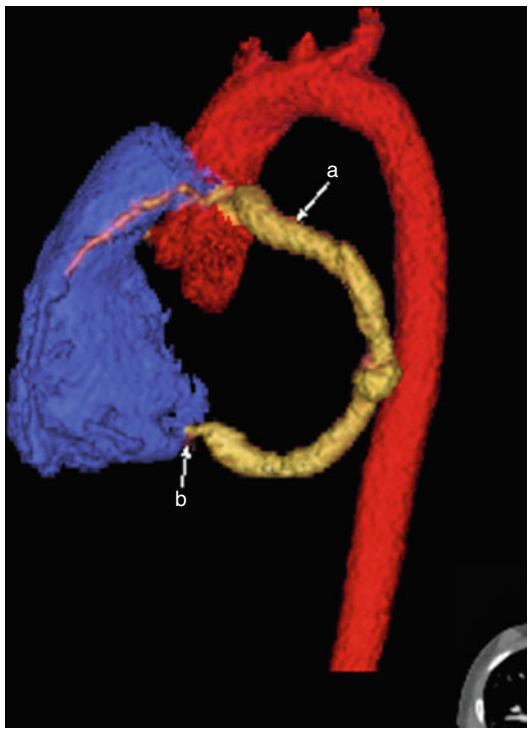

Fig. 8.8 Color-coded 3D reconstruction showing a coronary artery fistula (*b*) between the left coronary artery (*a*) and the right ventricle (*purple*)

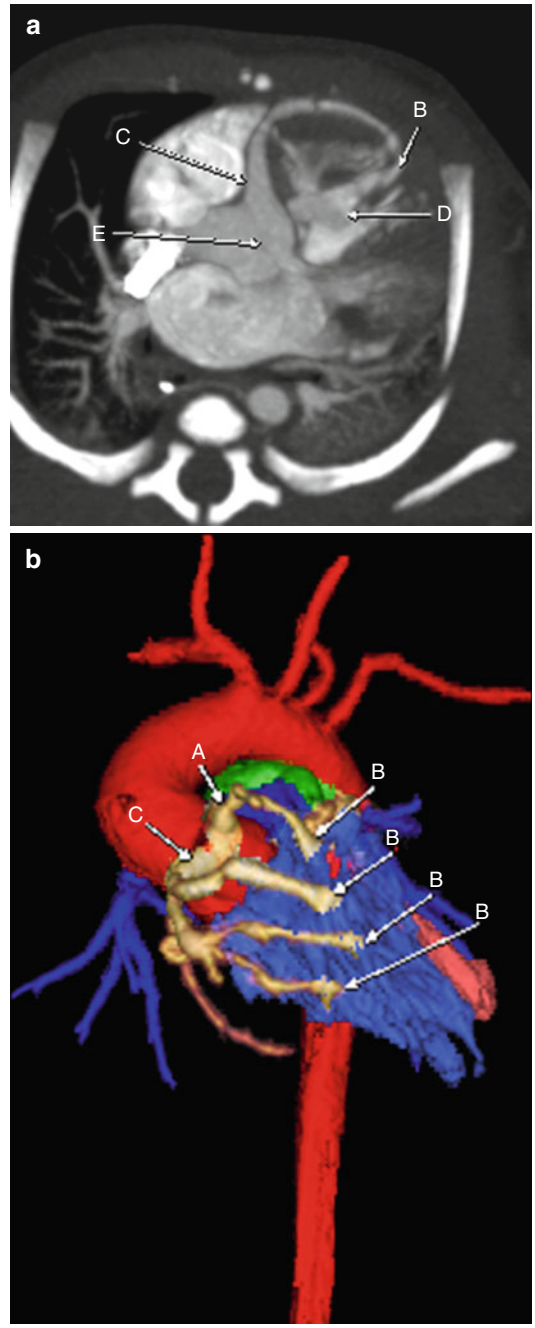

Fig. 8.9 Axial coronary CTA (**a**) and color-coded 3D reconstruction (**b**) images showing the right coronary artery (*C*) arising normally from the aorta (*E*) and forming multiple coronary artery fistulas (*B*) with the right ventricle (*D*, *purple*). A branch of the left coronary artery (*A*) also is noted to be forming a fistula with the right ventricle on the 3D reconstruction

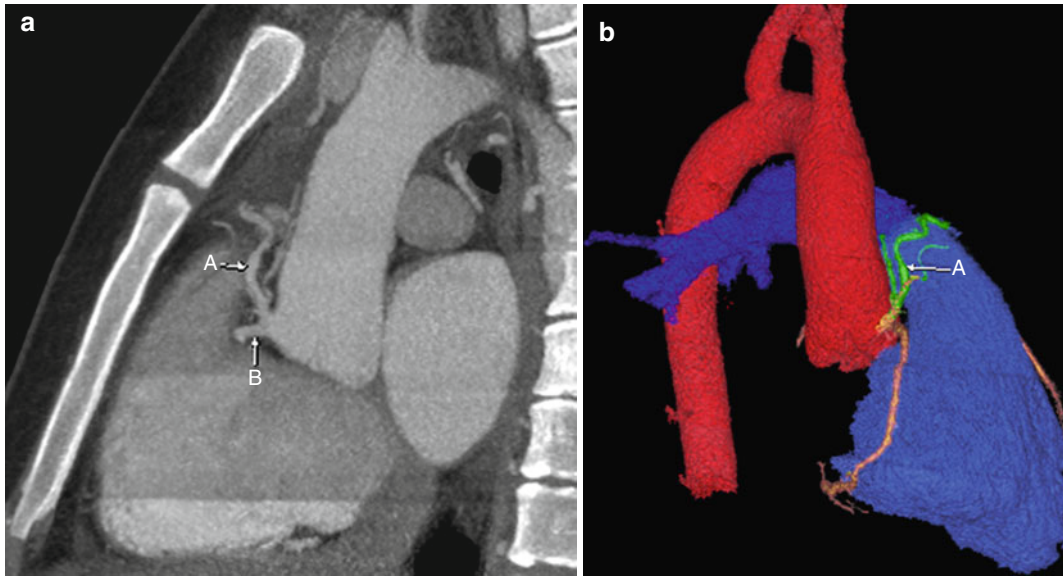

Fig. 8.10 Sagittal coronary CTA image (**a**) and color-coded 3D reconstruction (**b**) showing a branch (*A*, *green*) of the right coronary artery (*B*) forming a fistula with the pulmonary artery (*blue*)