Case 4
Cardiac CT in a 5-Month-Old Baby with VACTERL Syndrome after Cardiac Surgery

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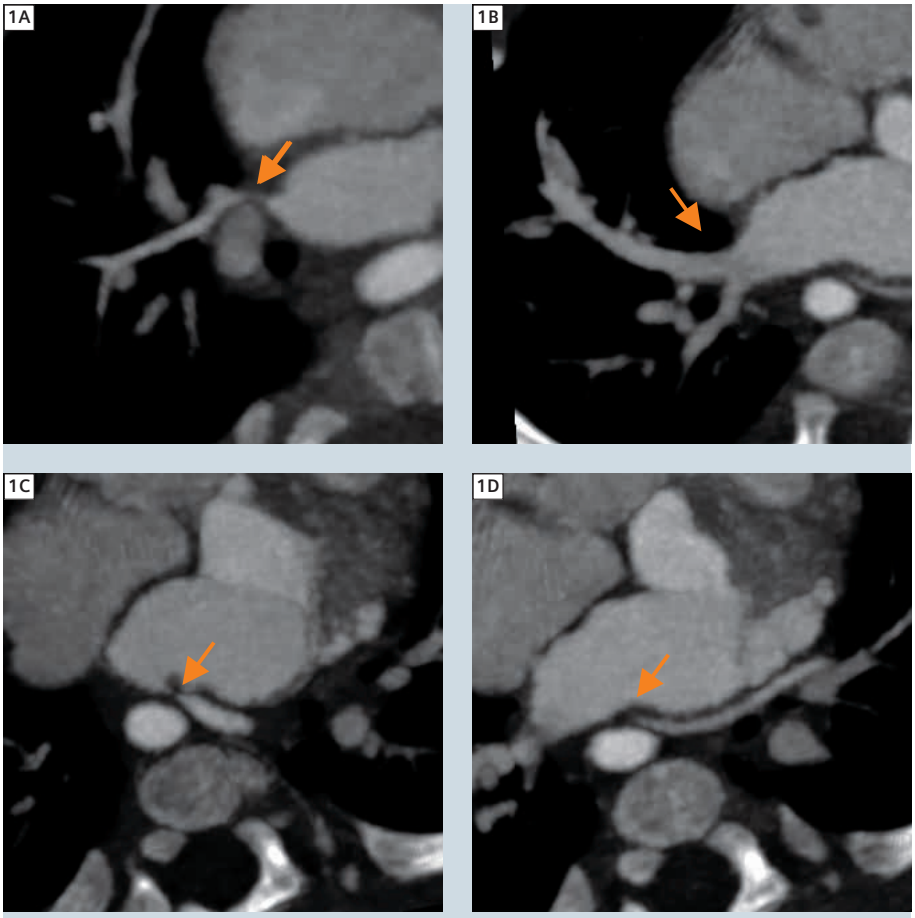


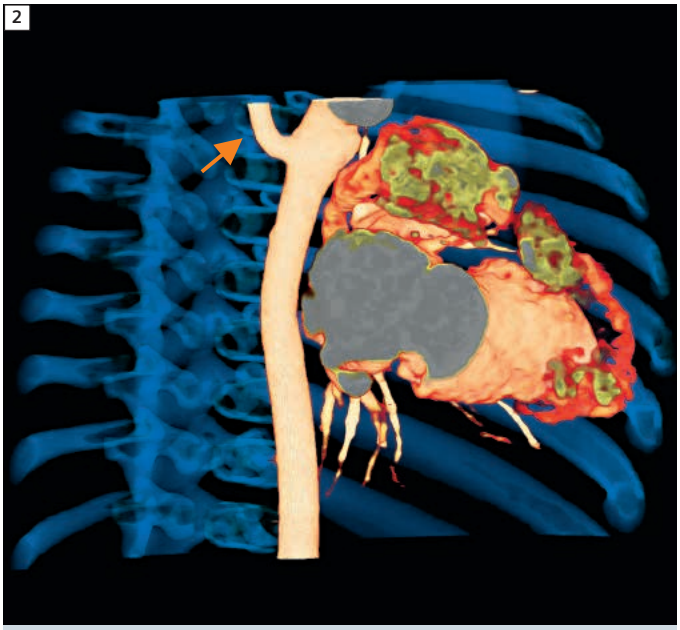
1 Axial Minimum Intensity Projection (MIP) images demonstrate the severely stenotic ostium of the right superior (Fig. 1A, arrow) and the normal right inferior pulmonary vein (Fig. 1B, arrow). The left superior vein has a high grade ostial stenosis (Fig. 1C, arrow) and the left inferior pulmonary vein is occluded (Fig. 1D, arrow).

HISTORY

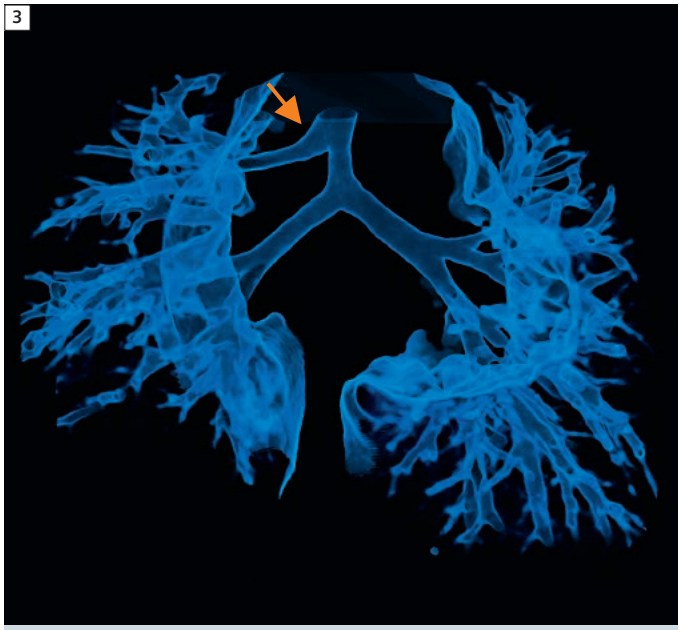
A 5-month-old baby boy with a history of double outlet right ventricle (DORV) with atrial septal defect (ASD), ventricular septal defect (VSD), patent foramen ovale (PFO) and VACTERL syndrome (unilateral renal agenesis, syndactyly, congenital hemivertebrae) was referred for cardiac CT. He underwent surgical repair with an ASD and VSD patch and PFO ligation at ten weeks of age. He was readmitted due to atrial tachycardia and worsening pulmonary hypertension. Cardiac catheterization revealed systemic pulmonary artery (PA) pressures and near atretic left pulmonary veins. The cardiac surgeon requested the CT for a detailed evaluation of the pulmonary veins prior to possible surgical repair.

DIAGNOSIS

The study was performed using the Flash mode and 80 kV. SAFIRE was used to allow further reduction of the radiation dose. The scan demonstrated four separate pulmonary veins, all of which drained into the left atrium. The right inferior pulmonary vein was normal, whereas the right superior vein had a severe ostial stenosis (Figs. 1A and 1B). The left superior pulmonary vein also had a severe ostial stenosis and the left inferior pulmonary vein was occluded at the ostium (Figs. 1C and 1D). There was no evidence of an ASD or VSD, and the PFO was successfully ligated. There was also a left aortic arch with aberrant right subclavian artery (Fig. 2). The left main coronary artery originated abnormally from the



2 A VRT image shows the aberrant right subclavian artery (arrow).



3 A VRT image shows the right upper lobe bronchus (arrow) originating from the trachea, a so-called pig bronchus.

left aspect of the non-coronary sinus (Fig. 4). The right upper lobe bronchus originated directly from the right aspect of the trachea, a so-called pig bronchus (Fig. 3).

COMMENTS

Children with congenital heart disease often require repeated cardiac imaging studies for follow-up. Even though echocardiography is the most important diagnostic modality, CT can be necessary in selected cases. Therefore, it is of the utmost importance to keep the radiation dose as low as possible. The use of the Flash cardiac mode combined with a low kV setting, allowed the study to be performed with very low dose. Newer reconstruction techniques, other than the classical filtered back projection algorithm, allow further reduction of dose while maintaining or even improving the image quality. Iterative reconstruction (SAFIRE) was used in this case, demonstrating the pulmonary venous and overall cardiac and aortocoronary anatomy in high quality with an estimated age-adapted effective radiation dose of only 1.88 mSv.

EXAMINATION PROTOCOL

Scanner	*SOMATOM Definition Flash*
Scan mode	*Flash mode*
Scan area	*Heart*
Scan length	*87 mm*
Scan direction	*Cranio-caudal*
Scan time	*0.2 s*
Tube voltage	*80 kV*
Tube current	*82 eff. mAs*
Dose modulation	*CARE Dose4D*
$CTDI_{vol}$	*1.32 mGy*
DLP	*21 mGy cm*
Effective dose	*1.88 mSv*
Rotation time	*0.28 s*
Pitch	*3.0*
Slice collimation	*128 x 0.6 mm*
Slice width	*0.6 mm*
Reconstruction increment	*0.6 mm*
Reconstruction kernel	*I26 / 41f (SAFIRE)*
Contrast	*350 mg/ccm diluted with saline*
Volume	*7 mL diluted to 10 mL*
Flow rate	*1 mL/s*
Start delay	*Bolus tracking*

4 An axial subvolume MIP image demonstrates the origin of the left main coronary artery (arrow) from the left aspect of the non-coronary sinus.

In clinical practice, the use of SAFIRE may reduce CT patient dose depending on the clinical task, patient size, anatomical location, and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task. The following test method was used to determine a 54 to 60% dose reduction when using the SAFIRE reconstruction software. Noise, CT numbers, homogeneity, low-contrast resolution and high contrast resolution were assessed in a Gammex 438 phantom. Low dose data reconstructed with SAFIRE showed the same image quality compared to full dose data based on this test. Data on file.