Ultra-low dose multiphasic coronary computed tomography angiography for pediatric patients with congenital heart diseases: A prospective cross-sectional study

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Background The use of coronary computed tomography angiography (CCTA) in children with coronary artery anomalies (CAA) is increasing. However, it remains technically demanding and the need to adapt acquisition parameters to a patient's cardiac characteristics has not yet been addressed.
Objectives The aim of the study was to prospectively assess the feasibility, in terms of diagnostic performance and dose reduction, of personalized multiphasic CCTA for pediatric patients.
Methods Fifty pediatric patients (mean age 6.1 ± 4.9 years) with CAA underwent a CCTA on last generation single-source CT equipment. Fifteen different acquisition patterns were used to trigger the acquisition at the best theoretical moment within the cardiac cycle. The appropriate pattern was automatically selected based on the patient's heart rate (HR) and HR variability, derived from the patient's electrocardiogram. Two independent radiologists qualitatively evaluated images.
Results All acquisitions fully answered the clinical question for a mean effective dose of 0.97 ± 0.34 mSv. Image quality qualified as ''good'' or ''excellent'' in 94% of cases (47/50). No examination was considered as ''not assessable'' but 6% (3/50) were scored as ''adequate'' for diagnosis (Fig. 1). For these three patients, motion artifacts were the main cause of average image quality. No significant visual differences were reported between the different coronary segments (mean score of 3.6 on a 4-point scale; 200 segments analyzed in total). No correlation between image quality and cardiac parameters were reported ($r = -0.19$ and $r = 0.00$ respectively for HR and HR variability).
Conclusions Personalized multiphasic CCTA acquisitions could be performed with diagnostic quality for a dose equivalent of less than four months of natural background irradiation.
Clinical trial registration ClinicalTrials.gov (NCT03194763).
Funding Montpellier University Hospital Clinical Research Program (UF 9785).

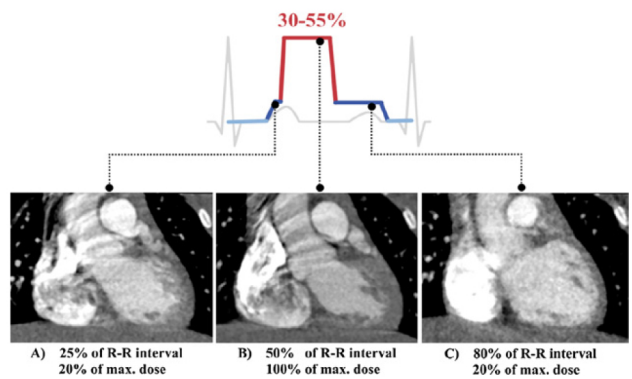

Fig. 1 Protocol example with an acquisition performed on a two-year-old boy with an irregular cardiac rhythm of 104 bpm. Different phases are presented here: (A) at 25%, (B) at 50%, and (C) at 80% of the R-R interval. Maximum dose (and signal) is delivered from 30% to 55%. Despite important injection artifacts, we observe a left coronary artery compression during the systolic phase (B), undetectable during diastole (C). This compression is not seen in early systole (A), highlighting the importance of multiple phase acquisitions for dynamic information.

Disclosure of interest The authors have not supplied their declaration of competing interest.