



# Adapting Cardiac Computed Tomography Protocols for Fontan Circuit Evaluation



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## INTRODUCTION

Success of staged palliation for patients with single ventricle physiology has led to a growing adult population who needs ongoing clinical assessment.<sup>1</sup> Patients who underwent Fontan palliation (Figure 1) represent a population with clinically complex physiology and unique limitations regarding diagnostic testing.<sup>2</sup>

We present a series of three patients with palliated single ventricle Fontan physiology who underwent diagnostic CCTAs at our institution outlined in Table 1 with their indications and respective images in Figure 3A-C.

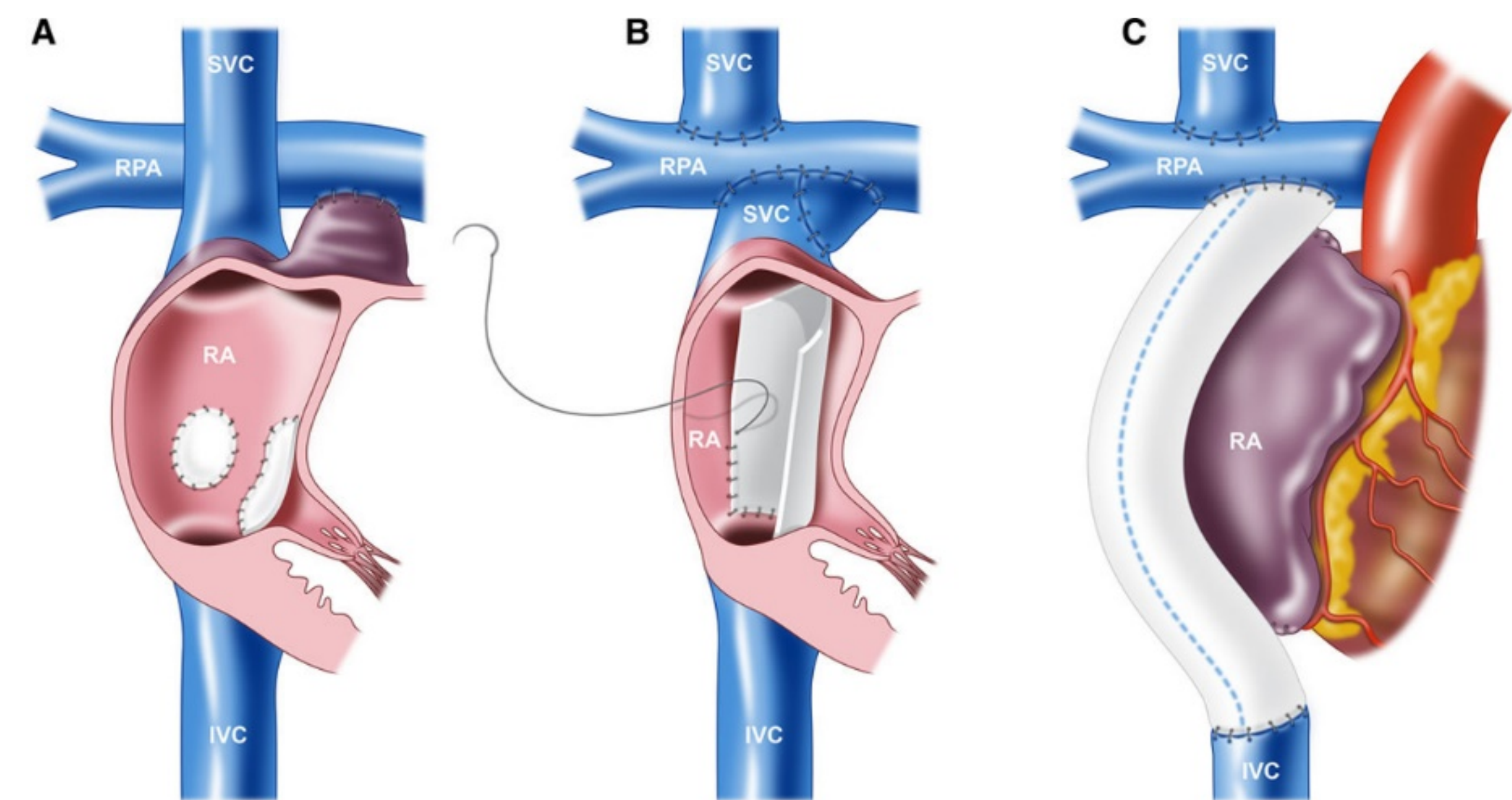
Our aim is to provide a streamlined, radiation dose reduced CCTA protocol capable of addressing specific clinical queries regarding the physiologic and anatomic status for the congenital heart disease population.

## CASE PRESENTATION

Cardiac computed tomography angiography (CCTA) provides a useful diagnostic alternative for patients unable to be adequately assessed by echocardiography or CMR.<sup>2, 3, 4</sup>

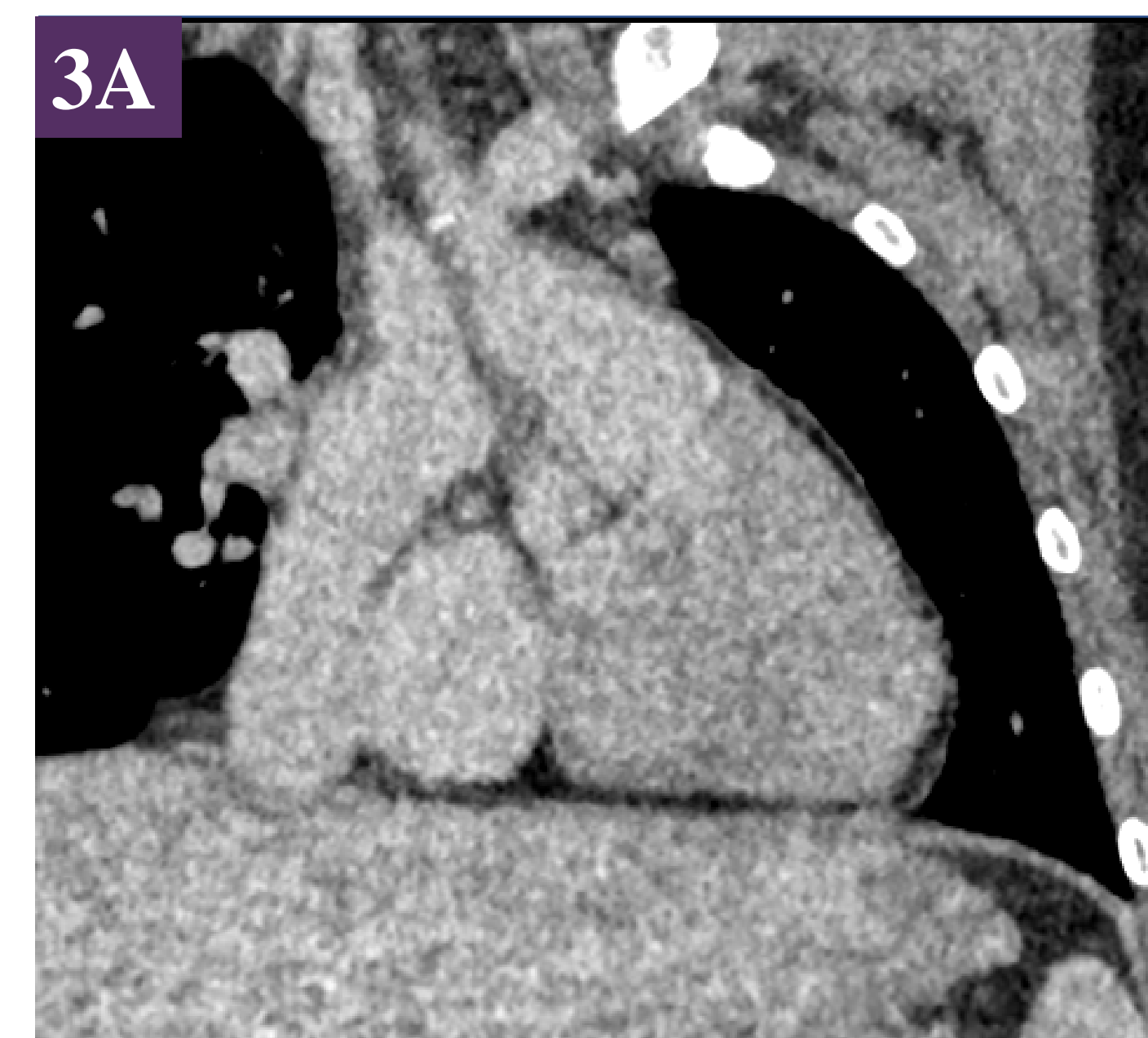
This modality obligatorily involves radiation exposure, a significant concern in a population with multiple radiation exposures during their lifetime.<sup>4</sup>

Adapting and optimizing standard cardiac CT protocols typically used for coronary imaging has been challenging due to streak artifact and differential filling within the Fontan circuit, complicating the ability to rule out circuit thrombus.



**Figure 1: Various techniques of the Fontan procedure.** A, Atriopulmonary connection. B, Lateral tunnel total cavopulmonary connection (TCPC). C, Extracardiac conduit TCPC. IVC indicates inferior vena cava; RA, right atrium; RPA, right pulmonary artery; and SVC, superior vena cava. **Table 1:** Corresponding patients with various Fontan circuits.

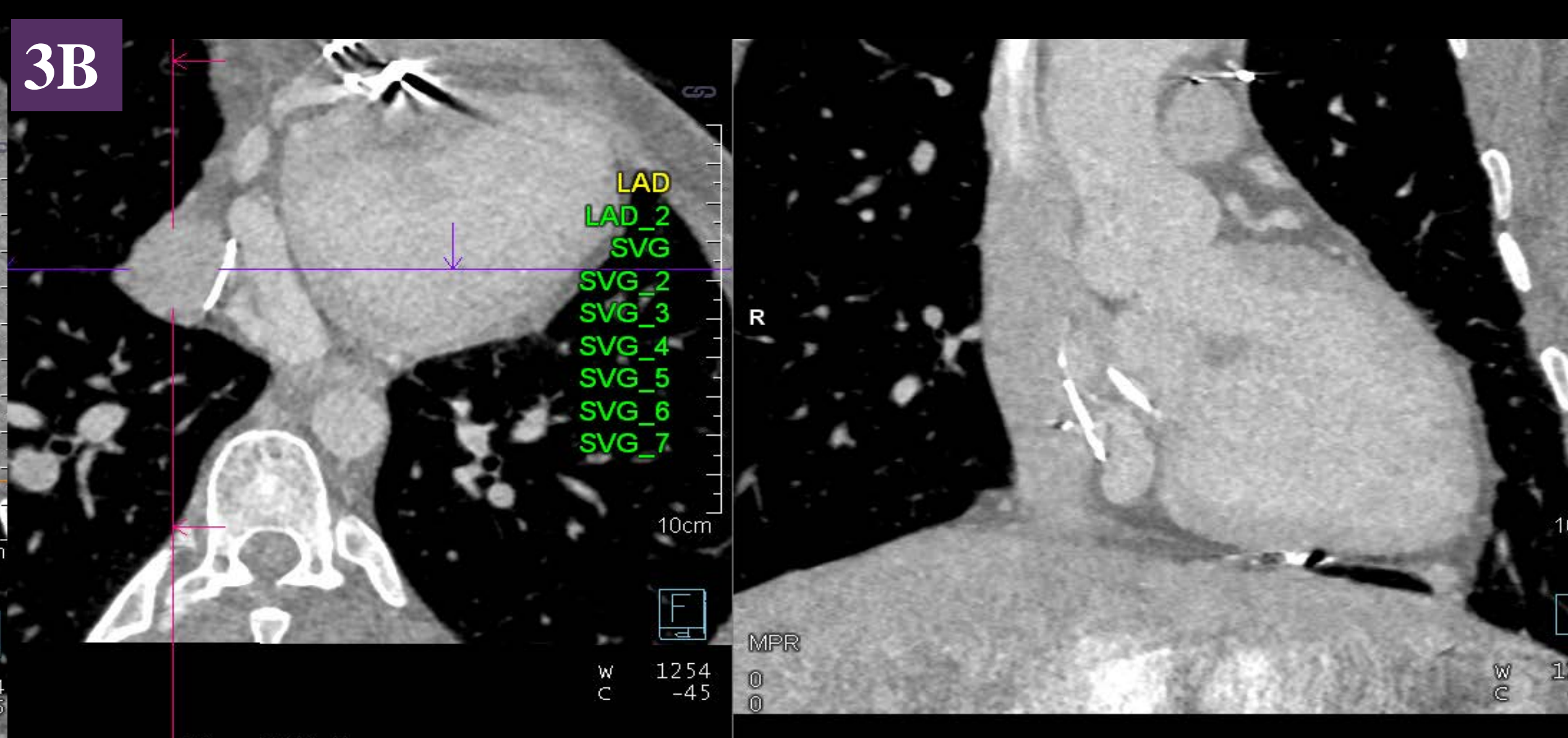
Table 1	Fontan Circuit
Patient A	13-year-old female Extracardiac
Patient B	30-year-old female Lateral Tunnel
Patient C	38-year-old male Extracardiac



**3A:** Obtained for probable balloon dilation of LPA; concern for longstanding left bronchial stenosis and further restriction of an arterial stent.



**3B:** Evaluate for coronary stenoses, veno-venous collaterals, and aortopulmonary collaterals.



**3C:** Evaluate for Fontan circuit (baffle) thrombus as well as veno/veno collateral filling.

Table 2	Equipment	Acquisition 1	Acquisition 2	Contrast	Injection Rate	Tube Voltage	DLP
Patient A	GE Revolution	Prospective ECG-triggered	Helical after 35 sec delay	99 ml (Isovue 370)	5.5 cc/sec	80 kV	240.1 mGy-cm
Patient B	Siemens Force Dual Source Scanner	Prospective ECG-triggered	High-Pitched Helical (Flash) after 25 sec delay	70 ml (Isovue 370)	N/A	100 kV	288 mGy-cm
Patient C	GE Revolution	Prospective ECG-triggered	Helical after 60 sec delay	55 ml (Visipaque 320)	4.5 cc/sec	80 kV	102 mGy-cm

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## DISCUSSION

We utilized a radiation reduced, single triphasic contrast injection in the upper extremity followed by arterial phase and delayed acquisitions (Table 2).

Bolus tracking and timing bolus techniques were used depending on scanning equipment.

Our delay acquisitions, in general, were much shorter than what is currently described in the literature.

## CONCLUSIONS

- Fontan palliation patients represent a population with clinically complex physiology and unique limitations regarding diagnostic testing.
- Cardiac computed tomography angiography (CCTA) provides a useful diagnostic alternative** for patients unable to be adequately assessed by echocardiography or CMR
- CCTA protocols can be adapted to answer most clinical questions while reducing radiation. **Combining an arterial phase and delayed acquisition**, yields diagnostic information for the arterial system and allows time for Fontan opacification, reducing streak artifact.

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