Transcatheter Aorto-Pulmonary Shunt Creation in Failed Fontan Palliation

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INTRODUCTION

Management of the failed Fontan is a challenge for cardiologists, riddled by issues such as imbalanced pulmonary blood flow. We report a unique strategy for increasing blood flow to one lung in a patient with chronic, diminished left lung flow after acute Fontan failure.

CASE DESCRIPTION

The patient is a 9-year-old male with history of tricuspid atresia with malposed great arteries who initially underwent Fontan palliation, however required Fontan takedown the following day due to low cardiac output syndrome. His procedural history is noted below:

- Modified Norwood procedure, atrial septectomy, and modified right BT shunt (age 5 days).
- Bidirectional cavopulmonary anastomosis (age 4 months).
- Stent implantation in the LPA (age 1)
- Fontan completion with a fenestrated extracardiac conduit with concomitant left pulmonary vein repair with Fontan takedown the following day (age 2).
- Repeat attempted sutureless repair of the left pulmonary vein (age 4).
- Stent implantation in both left pulmonary veins (age 6) with subsequent dilations.

To increase left lung blood flow, a novel strategy was carried out involving transcatheter creation of an aorta-to-left pulmonary artery (LPA) shunt using radiofrequency (RF) perforation and covered stent implantation from the descending aorta to the LPA. This was followed by placement of a microvascular plug between the right pulmonary artery (RPA) and LPA (figure 2).

PRE-OP ANGIOGRAPHY

Figure 1: Flow discrepancy on angiography with preferential superior cavopulmonary anastomosis flow to the RPA vs the LPA. There is no angiographic evidence of LPA stenosis through the previously placed LPA stent. Previously placed left pulmonary vein stents are also visualized.

POST-OP ANGIOGRAPHY

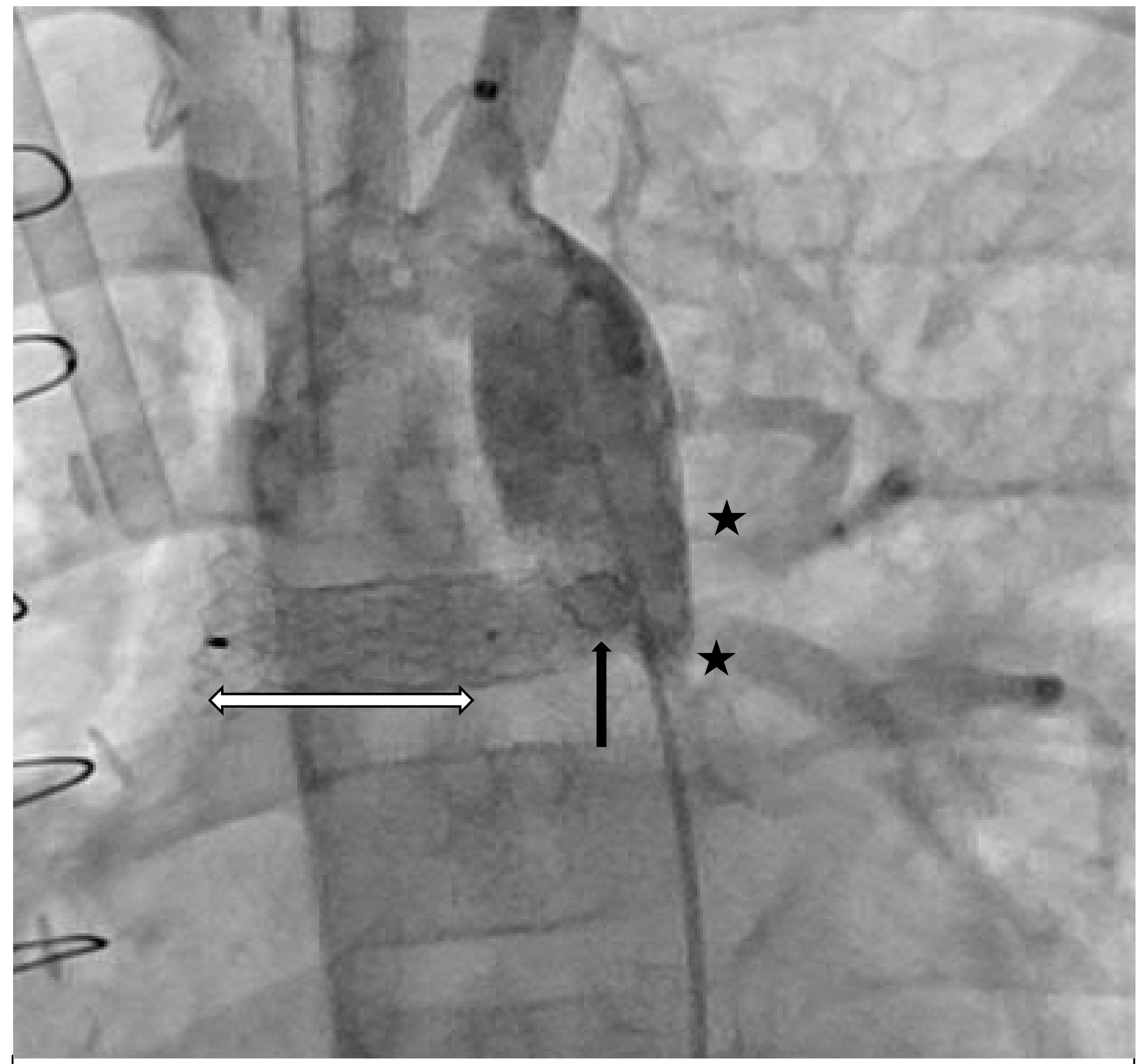

Figure 2: S/p aortopulmonary shunt creation using RF ablation and a 5x16 mm pre-mounted iCast Atrium stent (black arrow) and MPA occlusion and separation of the RPA and LPA using a Medtronic 9Q Microvascular Plug (white arrow). Note the LPA flow (stars) and absence of RPA flow.

PRE-INTERVENTION PRESSURE DATA (mmHg)

Site	Systolic	Diastolic	Mean	EDP
DSC AO	68	41	54	-
LV	79	4	-	8
RPA	10	10	10	-
RPCW	-	-	6	-
LPA	12	10	11	-
LPCW	-	-	17	-
LA	-	-	6	-

POST-INTERVENTION PRESSURE DATA (mmHg)

Site	Systolic	Diastolic	Mean	EDP
DSC AO	79	38	56	-
LV	90	3	-	15
SVC	-	-	17	-
LA	-	-	9	-

FOLLOW-UP PRESSURE DATA (mmHg)

Site	Systolic	Diastolic	Mean	EDP
FEM ART	108	59	81	-
SVC	-	-	10	-
LLPV	-	-	9	-
LA	-	-	6	-

DISCUSSION

Preferential RPA flow from the superior cavopulmonary anastomosis with resultant poor LPA flow was likely the main driving force for the development of recurrent left-sided pulmonary vein stenosis (figure 1). The placement of a microvascular plug dividing the RPA and LPA flows with the LPA supplied by the aorto-pulmonary shunt and the RPA flow supplied by the superior cavopulmonary anastomosis allowed for a higher driving pressure of flow to the high-resistance left lung instead of the low-resistance right lung (figure 2). Redirection of pulmonary blood flow can be used to rehabilitate a hypoplastic lung to promote growth of the lung tissue itself in addition to the pulmonary arteries and veins.

CONCLUSIONS

Transcatheter shunt creation may be an option for increasing pulmonary blood flow in complex situations where conventional palliative measures are not an option.

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