

Perigraft seroma formation after Norwood–Sano procedure



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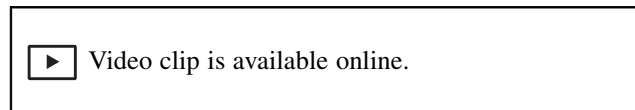
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Perigraft seroma after Norwood procedure with RV-PA shunt (yellow: shunt; red: seroma).

CENTRAL MESSAGE

Perigraft seromas are a rare complication of right ventricle-to-pulmonary artery shunts used during the Norwood procedure. Here, we present alternate approaches to the management of 2 such cases.



Perigraft seroma formation following insertion of polytetrafluoroethylene grafts in patients with congenital heart disease is a rare complication.¹ These grafts are often used during the Norwood procedure for patients with hypoplastic left heart syndrome (HLHS). Traditionally, the modified Blalock–Taussig–Thomas shunt is used; however, recently there has been a shift toward using right ventricle-to-pulmonary artery (RV-PA) shunts because of their improved short-term mortality.^{2,3} Little is known about the occurrence or management of RV-PA shunt perigraft seromas. Here, we present 2 cases of giant mediastinal seroma following RV-PA shunt insertion during the Norwood procedure. The institutional review board or equivalent ethics committee of the Children’s Healthcare of Atlanta approved the study protocol and publication of data (STUDY00001460, July 18, 2022). Patient written consent for the publication of the study data was waived by the institutional review board, as it was determined to be research not involving human subjects.

CLINICAL SUMMARY

A 3.25-kg full-term neonate with HLHS underwent the Norwood procedure with a 5-mm thin-walled removable ringed RV-PA conduit (cat. no. SRRT05030040L; W. L. Gore & Associates, Inc) on day of life 4. Postoperatively, he steadily was weaned off inotropes, with stable hemodynamics. He required bilateral chest tube placement for

pleural effusions. He was noted to have large a mediastinal shadow on radiography of the chest. A computed tomography (CT) scan showed a large hypodense collection in the superior mediastinum (Figure 1), a patent RV-PA shunt and distal anastomosis, no filling defects within the pulmonary arteries (PAs), and mild narrowing of the proximal bilateral branch PAs. The patient was asymptomatic, so we opted to monitor the suspected seroma with serial imaging. He was discharged home on postoperative day 52.

During outpatient follow-up, he was found to have an elevated gradient across the neo-aortic arch along with newly depressed ventricular function on echocardiography. CT imaging revealed a size discrepancy between the native and reconstructed aorta (Video 1). We then proceeded with arch revision and seroma evacuation. Intraoperatively, we found a large collection of proteinaceous material surrounding the RV-PA shunt. He again progressed well postoperatively except for some persistent tachypnea. A repeat CT scan showed reaccumulation of the seroma, a widely patent RV-PA shunt and distal anastomosis, and unobstructed central branch PAs (Figure E1). His respiratory status

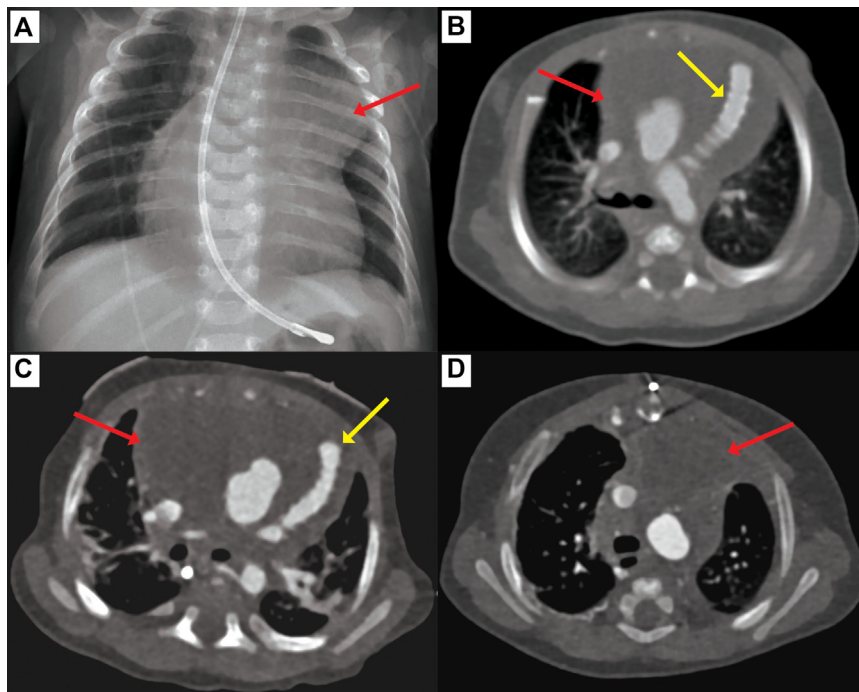
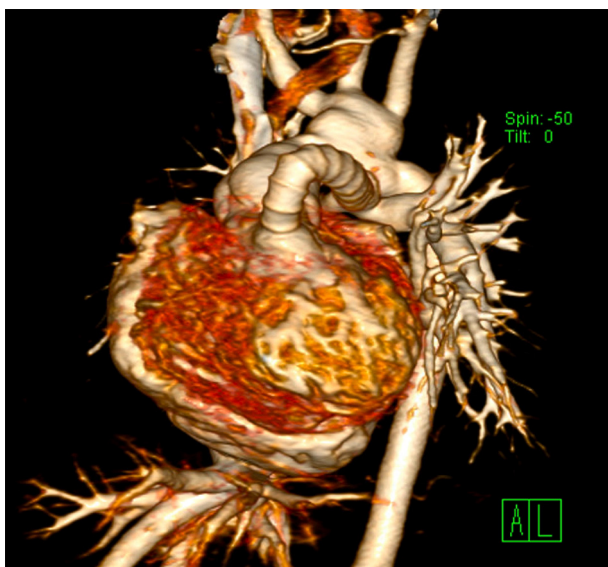


FIGURE 1. A, Postoperative radiography of the chest following Norwood procedure with mediastinal shadowing. B, Initial CT of the chest with perigraft seroma surrounding the ringed PTFE graft. C, Follow-up CT of the chest after mediastinal re-exploration and seroma evacuation showing reaccumulation of the anterior mediastinal seroma. D, Repeat CT of the chest following BDG (bidirectional Glenn) and repeat seroma evacuation showing near resolution of the anterior mediastinal seroma. *Yellow arrows* indicate the shunt; *red arrows* indicate the seroma.

stabilized, so we decided to address the seroma during his stage 2 palliative procedure (bidirectional Glenn) at 4 months of age. Intraoperatively, another well-organized

proteinaceous mass was found around the RV-PA conduit. He tolerated the procedure well, recovered fully, and was discharged home after 1 month. A repeat CT scan a few months later showed a persistent anterior mediastinal fluid collection, albeit much smaller than before surgery, and it continued to decrease in size over time on serial imaging.

A 2.32-kg neonate born at 36 weeks with HLHS also underwent the Norwood procedure with the same 5-mm ringed RV-PA conduit as above on day of life 5. Postoperatively, she was weaned off inotropes, with stable hemodynamics. She required chest tube placement for a right pleural effusion associated with respiratory insufficiency. There was concern for mediastinal seroma on radiography of the chest, which was confirmed with CT imaging (Figure 2). The CT also showed a widely patent RV-PA shunt and distal anastomosis, no filling defects within the PAs, and small main and branch PAs (no formal z scores reported) (Video 2, Figure E2). On postoperative day 22, she underwent mediastinal exploration. Intraoperatively, a very large amount of serous fluid and proteinaceous material was noted in the mediastinum and right pleural space. Her postoperative course was complicated by high chest tube output and left pleural effusion requiring chest tube placement. She ultimately recovered and discharged home at 2 months of age. On follow-up CT scans, there was no residual mediastinal seroma or pleural effusions.



VIDEO 1. Three-dimensional CT reconstruction showing the size discrepancy between the native and reconstructed aortic arch (ie, distal anastomosis). Video available at: [https://www.jtcvs.org/article/S2666-2507\(22\)00583-1/fulltext](https://www.jtcvs.org/article/S2666-2507(22)00583-1/fulltext).

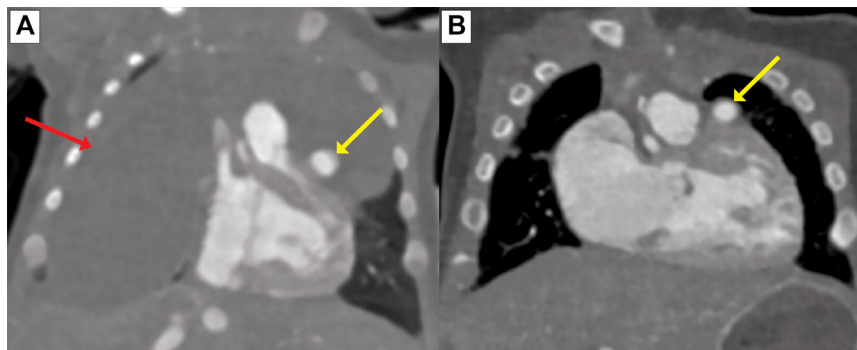


FIGURE 2. A, Initial postoperative CT of the chest following Norwood procedure showing a large mediastinal seroma surrounding the RV-PA shunt as well as a large right pleural effusion. B, Repeat CT of the chest following seroma evacuation and prolonged mediastinal/pleural drainage via chest tubes showing complete resolution of the seroma. *Yellow arrows* indicate the shunt; *red arrow* indicates the seroma.

DISCUSSION

Perigraft seromas are suspected to be the result of plasma ultrafiltration through the polytetrafluoroethylene graft, but it is not clear why this happens. Differences in oncotic or hydrostatic pressure may be to blame, and elevated

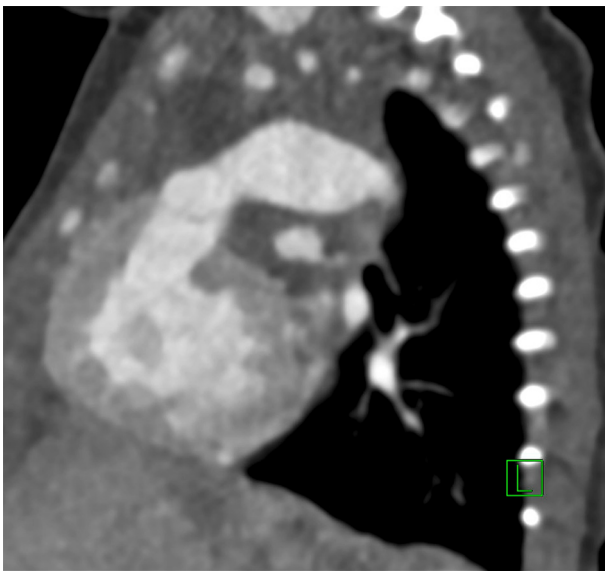
pulmonary vascular resistance could contribute to this. Our patients had either “mild narrowing” or “small” bilateral branch PAs, which is not uncommon in patients with HLHS. The low birth weight and early gestational age of the second patient increased her risk for morbidity and mortality following stage I palliation, but not specifically for elevated pulmonary vascular resistance. We did not identify any other pre- or postoperative variables in either case that might have contributed to seroma formation.

We routinely used 5-mm grafts for these shunts regardless of weight until recently when, for other reasons, we selectively started using 6-mm grafts in certain patients weighing more than 2.5 kg. The cohort remains too small, however, to draw any conclusions about the effect of graft size on seroma formation.

These cases illustrate the rarity of these seromas and may give some insight into how management can be tailored to the patient, as both immediate as well as delayed surgical interventions were employed with favorable initial outcomes in both cases.

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VIDEO 2. Sagittal CT images showing expected postoperative appearance of the aortic arch and descending aorta after Norwood procedure. Video available at: [https://www.jtcvs.org/article/S2666-2507\(22\)00583-1/fulltext](https://www.jtcvs.org/article/S2666-2507(22)00583-1/fulltext).

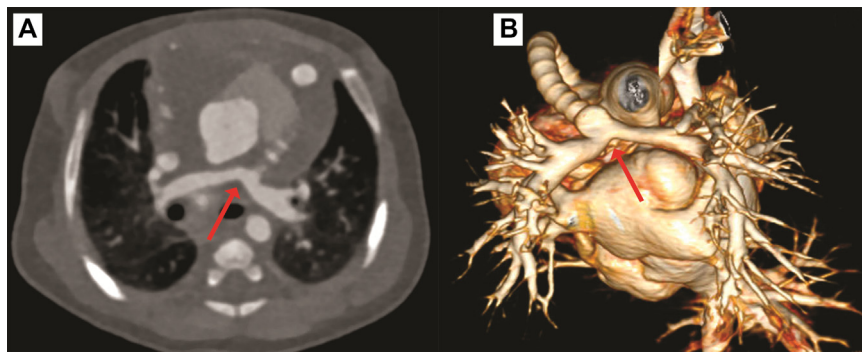


FIGURE E1. Axial CT projection (A) and 3-dimensional CT reconstruction (B) showing Sano shunt anastomosis with the confluence of bilateral pulmonary arteries (*red arrows*).

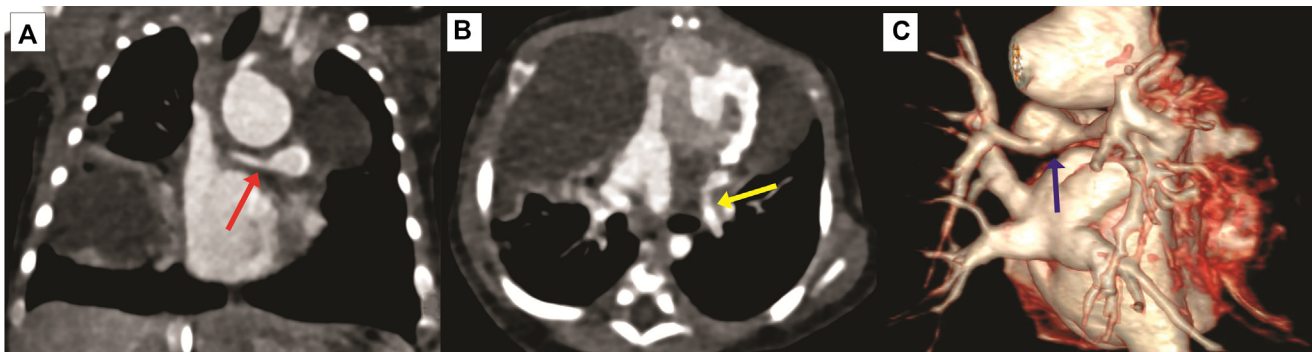


FIGURE E2. Coronal CT projection of the right pulmonary artery (A, *red arrow*). Axial CT projection of the left pulmonary artery (B, *yellow arrow*). Three-dimensional CT reconstruction showing confluence of bilateral pulmonary arteries (C, *blue arrow*).