Perigraft Seroma Formation After Norwood-Sano Procedure

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The Institutional Review Board (IRB) or equivalent ethics committee of the Children’s Healthcare of Atlanta approved the study protocol and publication of data. Patient written consent for the publication of the study data was waived by the IRB as it was determined to be a research not involving human subjects.

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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 two such cases.

Glossary of Abbreviations

PTFE – polytetrafluoroethylene
HLHS – hypoplastic left heart syndrome
RV-PA – right ventricle to pulmonary artery
CXR – chest x-ray
CT – computed tomography
PA – pulmonary artery
POD – post-operative day
PVR – pulmonary vascular resistance

Perigraft seroma formation following insertion of polytetrafluoroethylene (PTFE) grafts in congenital heart disease patients is a rare complication. 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 towards using right ventricle to pulmonary artery (RV-PA) shunts because of their improved short term mortality. Little is known about the occurrence or management of RV-PA shunt perigraft seromas. Here we present two cases of giant mediastinal seroma following RV-PA shunt insertion during the Norwood procedure. The Institutional Review Board (IRB) or equivalent ethics committee of the Children’s Healthcare of Atlanta approved the study protocol and
publication of data (STUDY00001460, 7/18/2022). Patient written consent for the publication of the study data was waived by the IRB as it was determined to be a 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 (Gore-Tex, cat # SRRT05030040L) on day of life 4. Post-operatively he steadily 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 chest X-ray (CXR). 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 (PA), and mild narrowing of the proximal bilateral branch PA’s. The patient was asymptomatic so we opted to monitor the suspected seroma with serial imaging. He was discharged home on POD 52.

During outpatient followup 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. Intra-operatively, we found a large collection of proteinaceous material surrounding the RV-PA shunt. He again progressed well post-operatively except for some persistent tachypnea. A repeat CT scan showed re-accumulation of the seroma, a widely patent RV-PA shunt and distal anastomosis, and unobstructed central branch PA’s (Supplemental Figure 1). His respiratory status stabilized, so
we decided to address the seroma during his stage 2 palliative procedure (bidirectional Glenn) at 4 months of age. Intra-operatively, another well-organized proteinaceous mass was found around the RV-PA conduit. He tolerated the procedure well, recovered fully, and was discharged home after one 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. Post-operatively, she 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 CXR 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 PA’s, and small main and branch PA’s (no formal Z-scores reported) (Video 2, Supplemental Figure 2). On POD 22 she underwent mediastinal exploration. Intra-operatively, a very large amount of serous fluid and proteinaceous material was noted in the mediastinum and right pleural space. Her post-operative 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.

Discussion

Perigraft seromas are suspected to be the result of plasma ultrafiltration through the PTFE graft, but it is not clear why this happens. Differences in oncotic or hydrostatic pressure may be to blame and elevated pulmonary vascular resistance (PVR) could contribute to this. Our patients
had either “mild narrowing” or “small” bilateral branch PA’s 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 PVR. We did not identified any other pre- or post-operative 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, though, 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.

References

Legends

Central Picture

Perigraft seroma after Norwood procedure with RV-PA shunt. (yellow – shunt, red – seroma)

Figure 1. Post-operative chest X-ray following Norwood procedure with mediastinal shadowing (A). Initial CT chest with perigraft seroma surrounding the ringed PTFE graft (B). Follow up CT chest after mediastinal re-exploration and seroma evacuation showing reaccumulation of the anterior mediastinal seroma (C). Repeat CT chest following BDG and repeat seroma evacuation showing near resolution of the anterior mediastinal seroma (D). (yellow – shunt, red – seroma)

Figure 2. Initial post-operative CT chest following Norwood procedure showing large mediastinal seroma surrounding the RV-PA shunt as well as a large right pleural effusion (A). Repeat CT chest following seroma evacuation and prolonged mediastinal/pleural drainage via chest tubes showing complete resolution of the seroma (B). (yellow – shunt, red – seroma)

Video 1. Three-dimensional CT reconstruction showing the size discrepancy between the native and reconstructed aortic arch (i.e. distal anastomosis).
Video 2. Sagittal CT images showing expected post-operative appearance of the aortic arch and descending aorta after Norwood procedure.

Supplemental Figure 1. Axial CT projection (A) and three-dimensional CT reconstruction (B) showing sano shunt anastomosis with the confluence of bilateral pulmonary arteries (red arrow).

Supplemental Figure 2. 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).