Suprasternal Approach for Implanting a Microaxial Left Ventricular Assist Device in a Failing Fontan Patient with Dextrocardia: A Case Report

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PII: S2666-2507(24)00062-2
DOI: https://doi.org/10.1016/j.xjtc.2024.02.007
Reference: XJTC 1622

To appear in: JTCVS Techniques

Received Date: 4 October 2023
Revised Date: 31 January 2024
Accepted Date: 7 February 2024

Please cite this article as: Chin C, Cevasco M, Maeda K, Mavroudis C, Suprasternal Approach for Implanting a Microaxial Left Ventricular Assist Device in a Failing Fontan Patient with Dextrocardia: A Case Report, JTCVS Techniques (2024), doi: https://doi.org/10.1016/j.xjtc.2024.02.007.

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Suprasternal Approach for Implanting a Microaxial Left Ventricular Assist Device in a Failing Fontan Patient with Dextrocardia: A Case Report

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Disclosure Statement: All authors declare no conflicts of interest.
Funding Statement: There are no funding sources to acknowledge.

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Article word count:
735
<table>
<thead>
<tr>
<th>Page</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Glossary of Abbreviations</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>ACHD</td>
<td>Adult congenital heart disease</td>
</tr>
<tr>
<td>27</td>
<td>MCS</td>
<td>Mechanical circulatory support</td>
</tr>
<tr>
<td>28</td>
<td>ECMO</td>
<td>Extracorporeal membrane oxygenation</td>
</tr>
<tr>
<td>29</td>
<td>AV</td>
<td>Atrioventricular</td>
</tr>
<tr>
<td>30</td>
<td>SVC</td>
<td>Superior vena cava</td>
</tr>
<tr>
<td>31</td>
<td>IVC</td>
<td>Inferior vena cava</td>
</tr>
</tbody>
</table>
Central Picture:

Schematic demonstrating the final result of impella 5.5 after suprasternal access.

Central Message:

Suprasternal exposure of the brachiocephalic trunk is an advantageous strategy for delivery of mechanical circulatory support in patients with complex adult congenital heart disease.
Introduction:

The prevalence of patients with congenital heart defects surviving to adulthood has given rise to the field of adult congenital heart disease (ACHD). The use of temporary mechanical circulatory support (MCS) for these patients is an area of burgeoning interest. However, ACHD patients are often plagued by diminutive peripheral vasculature. Additionally, for patients with cavopulmonary connections such as Fontan or bidirectional Glenn patients, the use of extracorporeal membrane oxygenation (ECMO) does not fully decompress the cavopulmonary circulation and has been described to lead to poor outcomes\(^1\). As such, non-traditional approaches to introduce ventricular assist devices may be necessary. In this case report we describe the use of suprasternal exposure of the brachiocephalic trunk for graft implantation for delivery of the Impella 5.5 platform in a failing Fontan patient with heterotaxy. Informed consent for inclusion of patient data was not obtained for this manuscript as the original procedure was emergent and the patient subsequently was not consentable through their passing; IRB approval was not required.

Case Description:

The patient was a 24 year old male with a history of heterotaxy syndrome with asplenia (A,D,D), dextrocardia, right sided aortic arch with mirror image branching, unbalanced complete atrioventricular canal with hypoplastic left ventricle, right ventricle-aorta with pulmonary atresia, bilateral SVCs with bridging innominate vein and interrupted IVC with azygos continuation (Figure 1). He previously had been palliated with a Blalock-Taussig shunt followed by a bidirectional Glenn and finally fenestrated, extracardiac Fontan.
The patient was hospitalized twice in the month preceding operative intervention with hypoxia and cardiogenic shock secondary to possible myocarditis, and left against medical advice both times. He was readmitted to the cardiology service in cardiogenic shock from presumed myocarditis. Medical management was attempted without significant improvement. An intraaortic balloon pump was placed, despite which his cardiac index was 0.8. Given these findings, he was emergently taken to the operating room. Due to his dextrocardia and sharp angulation of the aberrant right subclavian artery, left sided approach was chosen. A left axillary cutdown was performed however the axillary artery was found to only be 3-4 mm in size, and determined to be too small to accommodate an impella 5.5.

A suprasternal approach was then taken to expose the innominate artery. The proximal left carotid and left subclavian arteries were circumferentially dissected and after appropriate heparinization, controlled (Figure 2). A longitudinal arteriotomy was made and a 10 mm dacron graft was sewn on and tunneled out to the previously made left axillary incision. An impella 5.5 was then introduced successfully and positioned across the aortic valve with positioning confirmed by fluoroscopy and transesophageal echocardiography.

Postoperatively with the support of the impella 5.5 he was weaned off of epinephrine, vasopressin and norepinephrine, and supported only with milrinone. At P6 support with the impella 5.5 he was sustained with a flow of 3.6 L/min. Within 24 hours his lactate normalized. Unfortunately, on postoperative days 5-7 he developed multifocal pneumonia requiring
reintubation, with hypoxia and sepsis. Secondary to his overwhelming sepsis he developed multiorgan system dysfunction and passed on postoperative day 14.

Discussion:
The population of ACHD patients continues to grow, the field of cardiac surgery must be adept at multiple approaches to provide heart failure support platforms. ECMO does not fully support these patients, and a ventricular assist device may be more effective in patients with cavopulmonary connections. Specifically, we are reporting a novel approach of delivering the impella 5.5 platform via a suprasternal access to the base of a left-sided innominate artery in a patient with dextrocardia without splitting the sternum.

Several groups have published regarding the use of continuous flow ventricular assist devices in ACHD patients\(^2\). For patients with peripheral vasculature not suitable for impella 5.5 insertion, implantation directly into the aorta or into the innominate artery have been described via hemi or full sternotomy\(^3,4\). However, for many ACHD patients hemi or full sternotomy is not a benign endeavor in the setting of multiple prior sternotomies. As such it can be advantageous to access the proximal arch vessels without sternotomy.

To the best of our knowledge no one has implanted an impella 5.5 via the suprasternal approach without sternotomy in a dextrocardia patient. This approach is adapted from a previously published technique\(^5\) for suprasternal control of the innominate artery without requiring sternotomy. Suprasternal incision followed by vertical retraction on the sternal notch allowed adequate working space and visualization of the arch vessels to obtain vascular control and sew
on a 10 mm dacron graft. Adaptation of this technique demonstrates how strategies utilized in the
field of adult cardiac surgery can be modified and adapted for ACHD patients requiring
mechanical circulatory support.
References:


Figure Legends:

Figure 1: Three-dimensional reconstruction of the patient’s thoracic anatomy with the sternum removed to allow for visualization of the vasculature.

Figure 2: Suprasternal exposure of the innominate artery (A), followed by obtaining vascular control of branches (B). A 10 mm graft was then sewed onto the innominate (C) to create a conduit through which the Impella 5.5 device was introduced and positioned across the aortic valve (D).