Accepted Manuscript

Submission Date: 2024-06-22
Accepted Date: 2024-08-09
Accepted Manuscript online: 2024-10-17

The Thoracic and Cardiovascular Surgeon Reports

Management of patent ductus arteriosus endarteritis in children

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DOI: 10.1055/a-2444-9677

Please cite this article as: Canning J, Occleshaw C, Iyengar A J et al. Management of patent ductus arteriosus endarteritis in children. The Thoracic and Cardiovascular Surgeon Reports 2024. doi: 10.1055/a-2444-9677

Conflict of Interest: The authors declare that they have no conflict of interest.

Abstract:
The risk of patent ductus arteriosus infective endarteritis (PDA-IE) has significantly reduced since the introduction of antibiotics and surgical or interventional treatment strategies. However, diagnosis and adequate, timely management of PDA-IE remains challenging. We present the case of a nine-year-old girl with PDA-IE, illustrating our strategy to minimise complications in paediatric patients.

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Management of Patent Ductus Arteriosus Endarteritis in Children

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Abstract

The risk of patent ductus arteriosus infective endarteritis (PDA-IE) has significantly reduced since the introduction of antibiotics and surgical or interventional treatment strategies. However, diagnosis and adequate, timely management of PDA-IE remains challenging. We present the case of a nine-year-old girl with PDA-IE, illustrating our strategy to minimize complications in paediatric patients.

Keywords

Patent ductus arteriosus

Endarteritis

Management

Introduction

Infective endarteritis (IE) is a rare but severe complication in patients with patent ductus arteriosus (PDA). Prior to antibiotic treatment, IE accounted for an estimated 45% of deaths in this patient population (1). Nowadays, PDA-IE is extremely rare, and its incidence has declined due to routine surgical closure, changes in socio-economic circumstances and improved dental health (2).

Complications of PDA-IE include vegetations in the pulmonary artery or at the pulmonary valve and septic pulmonary embolism. Rupture is a rare but life-threatening complication due to aneurysm formation (3).

Management of acute PDA-IE remains challenging, and currently no recommendations regarding timing and approach of surgical intervention and the role of advanced imaging techniques exist (4). This case report summarises our approach.

Case Description

A previously well nine-year-old girl was referred to our centre with IE associated with an undiagnosed PDA. The patient presented to a local hospital with persistent nausea, fatigue, abdominal discomfort, but was initially discharged. Eight days later, the patient returned with fever, cough, an urticarial rash, pleuritic chest and left hip pain. The patient reported 5 kg of weight loss over the preceding month.

On examination, the patient was febrile 38.8°C with mild tachycardia and tachypnoea. There was a new 4/6 continuous murmur with thrill. Splenomegaly

and left upper quadrant tenderness were appreciable. A single 4 mm Janeway lesion of the plantar surface of the right foot was noted.

Echocardiogram demonstrated a moderate-sized PDA with left-to-right shunting, left ventricular dilatation (LVEDV 138ml, Z-score +5.4, Figure 1A and B) and low normal LV function (EF 56%). No indirect signs for pulmonary hypertension, including normal right ventricular systolic pressure (RVSP) and no flattened interventricular septum. Bloods showed elevated CRP of 13mg/L. Chest x-ray demonstrated mild cardiomegaly and increased pulmonary vasculature markings. Peripheral blood cultures grew a pan-sensitive *Streptococcus sanguinis.* The patient was started on intravenous amoxicillin plus clavulanic acid on day two of admission with immediate defervescence of fever and improvement in fatigue, and was changed to ceftriaxone on day seven.

A cardiac-CT was performed to characterise the PDA morphology and exclude aneurysm formation(Figure 1C). There was thickening around the duct and multiple small opacities throughout the lungs bilaterally suspicious for septic emboli.

The patient continued antibiotic treatment and underwent a ligation and division of the PDA on day 15 after hospital admission. The preoperative transoesophageal echocardiogram (TOE) showed a vegetation in the main pulmonary artery (MPA) where the PDA jet was directed to. The procedure was performed via median sternotomy on cardiopulmonary bypass. The PDA was divided and the vegetation in was removed, requiring a MPA-plasty. Postoperative course was

uncomplicated and IV antibiotics were continued for additional four weeks after surgery. The family of the patient provided informed consent to present this data.

Discussion

Across the literature, treatment strategies for paediatric PDA-IE are variable and different timing and surgical approaches are described (Supplementary Table 1).

Most authors treat with antibiotics for 4-6 weeks, with surgical ligation following the antibiotic course. Acute complications of PDA-IE may occur and include aneurysm formation, periductal haematoma and rupture of the PDA, which we have experienced in an historic case with fatal outcome (3). From this experience our management has changed to minimize the risk of life-threatening complications and carefully plan the surgical approach.

Our algorithm (Figure 2) includes an early CT-angiogram when PDA-IE is suspected on TTE, to determine if an aneurysm warranting immediate surgical intervention, large vegetations or pulmonary emboli are present. Aneurysms either form a thin walled saccular or fusiform dilatation of the DA. In the absence of an aneurysm or haematoma, the patient should receive antibiotic treatment at for about 2 weeks prior to surgery. If fever is persistent despite appropriate antibiotic treatment, we suggest to proceed with urgent surgery. If there is suspicion of pulmonary hypertension on echocardiogram, pulmonary hypertension needs to be excluded by invasive testing.

In addition to a transthoracic echocardiogram we perform a transoesophageal echocardiogram (TOE) prior to surgery to assess for pulmonary vegetations or lesions, which might influence the surgical approach. Depending on the findings and patient's age and weight, it might be beneficial to perform duct ligation and resection of vegetations via median sternotomy on cardiopulmonary bypass rather than lateral thoracotomy. This has been described in the literature when larger vegetations in the pulmonary arteries or at the pulmonary valve were present. In more recent studies, transcatheter closure of the PDA after completing antibiotic treatment has been described in selected cases (5). This should only be considered in patients whose bacteraemia is cleared by antibiotics, and who have no aneurysm, vegetation, or adventitial/ intimal thickening.

Conflict of interest

The authors have declared that no competing interests exist

Acknowledgment

We thank the family for the consent to share this case.

Data Availability Statement

All relevant data are within the manuscript and its Supporting Information files.

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Figure 1: A) Four chamber view with volume loaded left ventricle. B) Ductal view with large PDA and left-to-right shunting. C) 3D-reconstruction of cardiac CT showing PDA.

Figure 2: Strategy for paediatric PDA-IE.

Author	Year	Age of patient	Septic emboli/ vegetations	Imaging modalities	Duration of antibiotic treatment (weeks)	Timing of intervention after diagnosis	Intervention	Details of surgical/interventional approach
Grewing	2022	15 y	PA	TTE, CT	6	6 w	Transcatheter device closure	AVP II
Saucedo-Orozco	2021	9-38 y	PA	17/17 TTE 6/17 TOE 9/17 CT 2/17 MRI	N/S	Transcatheter device closure after 3 m Surgical intervention N/S	16 surgical 1 Transcatheter device closure	13 patients on CPB 10/17 transpulmonary approach 3 patients with PDA ligation 1 ADO
Callegari	2019	7 w	PE	TTE, MRI	4	NA	NA	NA
Malviya	2016	7 y	PA and right atrium	TTE, CT	N/S died of sepsis	NA	NA	NA
Ferreira	2011	4 m	-	TTE	6	6 m	Surgical	N/S
Grover	2008	2 x 1.5 m	PA (one patient)	TTE	6, 4	NA	N/S	NA
Celebi	2007	2 m	PA	TTE	6	16 w	Surgical	Thoracotomy without CPB
Kiani	2007	5 y	PA	TTE	N/S	Urgent surgery 2 w after second presentation/ 7 m after first	Surgical	Median sternotomy CPB Transpulmonary resection of pulmonary artery aneurysm, PA repair, PDA ligation
Stewart	2006	6 m	-	TTE, CT	N/S	Urgent for ruptured DA and deterioration	Surgical	Median sternotomy CPB Resection of ruptured ductal aneurysm, repair with pericardial patch
Sadiq	2004	14 patients 6 m to 16	PA (12 patients) PV (2 patients)	TTE	3-10	Following antibiotic treatment	5 Surgical 8 Transcatheter device	5 x ligation without cardiopulmonary bypass One ligation without further

		y					closure	details 2 x Rashkind umbrella device 3 x Amplatzer device 3 x coil occludion
Bilge	2004	11 y	PA, PE	TTE, V/Q scan	4	>4	Surgical	Ligation of PDA
Medeiros Botta	2002	1 y	N/S	TTE	3	Urgent, ruptured in perfusional entrance	Surgical	Aneurysmectomy of PDA aneurysm

Abbreviations: AV, aortic valve; CPB, Cardiopulmonary bypass; M, months; N/S, not specified; NA, not applicable; PA, Pulmonary artery; PDA, Patent ductus arteriosus; PE, Pulmonary embolism; V/Q scan, ventilation-perfusion (VQ) scintigraphy scan; W, weeks; Y, years.

Supplementary Table S1 Literature review of PDA-IE cases