Original Article

Immediate and medium-term outcomes of ductal stenting in neonates and infants

Carlos Mariño Vigo[a,*], Gorky Mori Pinedo[b], Cesar Salinas Mondragón[a], Maria Lapoint Montes[a], Silvia Alegre Manrique[a], Geen Huaringa Bejarano[a], Edilberto Estela Chunga[a]

[a] *Instituto Nacional de Salud del Niño, Lima, Peru*
[b] *Hospital Nacional Dos de Mayo, Lima, Peru*

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ABSTRACT

Background: The implantation of stents to keep the ductus arteriosus patent in cyanotic congenital heart disease is an alternative to the modified Blalock-Taussig surgery (mBT) in high-risk patients. This study describes the immediate and medium-term outcomes of stent implantation in neonates and infants with duct-dependent pulmonary circulation.
Methods: This was a descriptive and prospective study including different cyanotic congenital heart diseases treated between 2014 and 2015.
Results: Fourteen patients with a mean age of 46 days, and mean weight of 4.5 kg were assessed, and pulmonary artresia with interventricular communication was the most treated condition. The femoral artery approach was used in 70% of procedures; carotid approach was used in the remaining cases. Stents of 3.5 x 12 mm were used in most cases, and implant success was achieved in 78% of interventions (11/14). The failed cases were referred to surgery – one of them was an emergency, which resulted in death. Ductal spasm occurred in < 48 hours in three patients who required mBT, with favorable outcome. Complications after discharge and within the first 30 days included stent thrombosis (2/11), one of which was controlled with redilation, another progressed to death, and one sudden death (1/11). The overall mortality was 21.4% (3/14). A patent ductus arteriosus in the first 6 months was present in five cases, which underwent palliative surgery.
Conclusions: The initial experience of ductal stenting showed favorable immediate outcomes, but in the medium term, little more than a third of the cases maintained a patent ductus arteriosus within 6 months.

Resultados imediatos e de médio prazo da intervenção com stent ductal em recém-nascidos e lactentes

Palavras-chave:
Cardiopatias congênitas
Cateterismo cardíaco
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RESUMO

Introdução: O implante de stents para manter o ducto arterial patente na cardiopatia congênita cianótica é uma alternativa à cirurgia de Blalock-Taussig modificada (BTm) em pacientes de alto risco. Descrevemos os resultados imediatos e de médio prazo do implante de stent em neonatos e lactentes com circulação pulmonar ducto-dependente.
Métodos: Trata-se de estudo descritivo e prospectivo, que incluiu diferentes cardiopatias congênitas cianóticas tratadas entre 2014 e 2015.
Resultados: Avaliamos 14 pacientes, com média de idade de 46 dias e pesando 4,5 kg, sendo a atresia pulmonar associada à comunicação interventricular a cardiopatia mais tratada. A abordagem pela artéria femoral ocorreu em 70% dos procedimentos e, nos demais, por via carotídea. Stents de 3,5 × 12 mm foram usados na maioria dos casos, e o sucesso do implante foi obtido em 78% das intervenções (11/14). Os casos de insucesso foram encaminhados para cirurgia – uma delas em situação de urgência, que resultou em óbito. Ocorreu espasmo ductal < 48 horas em três pacientes que necessitaram de BTm, com evolução favorável. Complicações após a alta e nos primeiros 30 dias incluíram trombose de stent (2/11), uma delas controlada com redilatação e outra que evoluiu para óbito, e uma morte súbita (1/11). A mortalidade total foi de 21,4% (3/14). A patência do ducto arterial nos primeiros 6 meses foi obtida em 5 casos que foram submetidos à cirurgia paliativa.

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* Corresponding author: Instituto Nacional de Salud del Niño, Serviço de Cardiologia, Av. Brasil, 600, Lima, Peru.
E-mail: cmarino@insn.gob.pe (C. Mariño Vigo).
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Conclusões: A experiência inicial de implante de stent ductal mostrou resultados imediatos favoráveis, e, em médio prazo, mais de um terço dos pacientes com circulação pulmonar ducto-dependente manteve seus canais patentes.

Introduction

Congenital heart disease patients with duct-dependent pulmonary circulation require urgent treatment in the first days of life to ensure pulmonary blood flow before the duct closes. Prostaglandin E1 infusion is generally effective in maintaining the patency of the ductus arteriosus.[1] Pulmonary atresia with intact ventricular septum, extreme tetralogy of Fallot, tricuspid atresia with pulmonary atresia, and critical pulmonary stenosis, among others, are conditions dependent on continuing patency of the ductus arteriosus.

Traditionally, the first treatment option is the modified Blalock-Taussig (mBT) surgery; however, it can be limited by the lack of experience of the service or due to patient-related factors such as very severe disease or very low birth weight.[2] The mBT surgery consists of a systemic pulmonary shunt, and is mostly performed as a palliative surgery to improve pulmonary blood flow prior to the definitive surgery. Although this surgery has been used for over 50 years, there is still high morbidity and mortality, particularly among newborns and in early infancy.[3,4]

In 1992, Gibbs et al. first described maintenance of ductal patency with stenting during cardiac catheterization.[5] Since then, stenting has achieved wide acceptance as a reliable alternative, considered to be as safe and effective as mBT surgery in high-risk patients. Moreover, it has other potential advantages such as reducing the number of palliative surgeries and optimize the time for definitive surgical repair.[6,7]

This study presents an early experience with this technique in newborns and infants with cyanotic heart disease and duct-dependent pulmonary circulation undergoing ductal stenting as an alternative to conventional surgery. The immediate and medium-term outcomes and complications are presented.

Methods

Newborns and infants with duct-dependent congenital heart disease underwent ductal stenting from January 2014 to March 2015, at the Instituto Nacional de Salud del Niño de Lima and at the National Hospital Dos de Mayo, in Lima, Peru, with prior informed consent.

Patients were selected by a medical team, and presented with echocardiography and, in most cases, CT angiography (Fig. 1). These patients were considered to be at high surgical risk, so they were referred to percutaneous intervention.

Under general anesthesia and endotracheal intubation, the approach was made considering the most favorable access to the duct in accordance with its origin in the aortic arch or descending aorta[8] (previously defined in CT angiography, or if not available, by echocardiogram). An 5 F sheath was placed using Seldinger technique in the femoral access (whether venous or arterial), or through direct dissection and puncture when in the carotid artery.

All patients were started on prostaglandin E1 infusion, and the dose was gradually reduced or suspended when the duct was approached, and the guide passed through the narrowest area; this allowed for a clear definition of the constriction, minimizing the risk of hypoxic crisis.

Angiography was performed with pigtail catheter or, on other occasions, through a guide catheter near the duct.

A catheter guide was used to address the duct and then to cross the narrowest area with a 0.014" angioplasty guide. Stents 3.0/12 mm, 3.5/16 mm, or 4.0/12 mm were used in this study.

At the beginning of the procedure, 100 U/kg intravenous heparin was given; at the end, antiplatelet therapy was started with acetylsalicylic acid 5mg/kg and clopidogrel 2 mg/kg.

The implantation was considered successful when oxygen saturation above 75% was achieved, along with complete patency of the duct with adequate flow to the pulmonary branches. The follow-up was clinical: a 24-hour control echocardiogram was performed after the procedure, and radiological controls were performed as needed (Fig. 2).

Figure 1. Computed tomography angiography of heart and great vessels in a case of pulmonary atresia and interventricular communication.

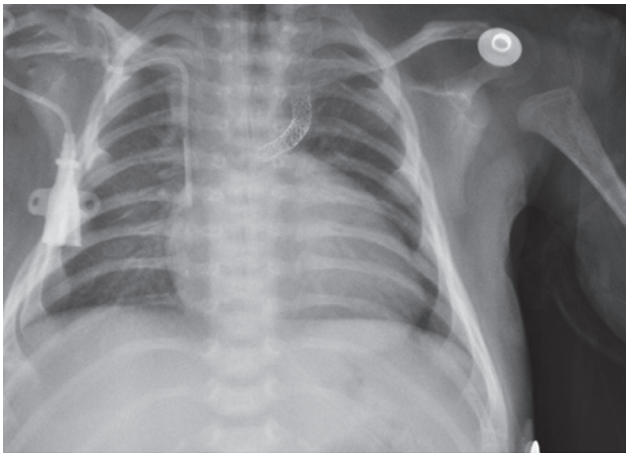

Figure 2. Control X-ray on the fifth day after ductal stent implantation in a case of pulmonary atresia and interventricular communication.