Complications of Aortic Stenting in Patients below 20 Years Old: Immediate and Intermediate Follow-Up

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Abstract

Background: Optimal timing and mode of treatment for patients with coarctation of the aorta (COA) remain controversial, particularly in children. Surgery, balloon dilatation, and stent implantation have all proven effective in the treatment of moderate or severe obstruction. The aim of this study was to investigate the complications of COA stenting angioplasty in pediatric patients.

Methods: This retrospective, descriptive study was conducted on patients less than 20 years of age who underwent aortic stenting angioplasty because of congenital COA in the pediatric catheterization laboratory of Rajaie cardiovascular, medical and research Center, Tehran between 2005 and 2010.

Results: A total of 26 patients (18 [65.4%] males and 9 [34.6%] females) with congenital COA who had undergone aortic stenting angioplasty were recruited. Nineteen (73.1%) of these patients had native COA and 7 (26.9%) had recurrent COA. Most of the early complications were minor and temporary; only one patient developed early major complications. During the follow-up, whereas none of the native group patients developed late complications, in the re-COA group 28.57% of the patients had re-stenosis and 14.28% had chronic systemic hypertension, requiring drug therapy.

Conclusion: Our investigation into post-stenting complications in patients with native COA and re-COA showed that endovascular stenting could be an effective and safe method, even in young patients with native COA.

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Introduction

Coarctation of the aorta (COA) occurs in about 6% to 8% of patients with congenital heart disease. If left untreated, COA is likely to have a poor natural history. Campbell's natural history data for untreated COA documented a mean age at death of 34 years (median = 31 years); 75% of the patients died by 46 years of age. The most common causes of death were congestive heart failure (26%), aortic rupture (21%), bacterial endocarditis (18%), and intracranial hemorrhage (12%). Given such a poor prognosis, it is clear that intervention is indicated in almost all patients with COA. CRAFOORD AND NYLIN IN 1944 PERFORMED THE FIRST SURGICAL REPAIR OF COA. A SURGICAL REPAIR REMAINS THE CONVENTIONAL TREATMENT FOR MOST CHILDREN WITH COA.

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Complications of aortic stenting in patients with congenital coarctation of the aorta have been reported in both native and re-coarctation (re-COA) patients. balloon angioplasty is commonly used to treat coarctation of the aorta, and it is based on the idea that the balloon can dilate the coarctation area. although balloon angioplasty is a minimally invasive procedure, it can be associated with complications such as dissection, aneurysm formation, and restenosis.

Methods

This study was a retrospective, descriptive study performed on patients younger than 20 years old who underwent aortic stenting angioplasty between 2005 and 2010 in the pediatric catheterization laboratory of the Rajaie Cardiovascular, Medical, and Research Center, Tehran. the study population consisted of 26 patients with congenital coarctation of the aorta. balloon angioplasty was used as the treatment method, and the stents used were the bare Cheatham platinum (CP) stent in 13 cases, covered CP stent in 9 cases, Max LD (EV3) stent in 3 cases, and pre-mounted Racer (Medtronic) stent in 1 case. the balloons utilized were BIB (numed) in 23 cases and Z-Med in 2 cases. in one patient, who had middle aortic syndrome, the pre-mounted Racer (Medtronic) stent was used.

Results

The demographic data of the patients, including age, weight, type of treatment, procedure duration, type of anticoagulant, and duration of antiplatelet consumption therapy, follow-up duration, and early and mid-term complications of this procedure, were recorded. the data are described as mean ± standard deviation (SD) for the interval variables and count (%) for the categorical variables. the chi-square test or the Fisher exact test and the One Sample Kolmogorov-Smirnov test were used to explore the fitness of the interval variables to normal distribution. the chi-square test or the Fisher exact test and the Mann Whitney U test were employed to compare the data between the two groups. SPSS 15 for Windows (SPSS Inc., Chicago, Illinois) was used to conduct the statistical analyses.

Complications were divided into two categories: early (first 48 hours) and mid-term (up to the end of the follow-up period). the early complications were divided into two categories of minor and major. early minor complications consisted of transient arrhythmia, nausea and vomiting, transient abdominal pain, transient pulse weakening of the lower limbs, urinary retention, and mild bleeding of the vascular access site without need for transfusion. early major complications were comprised of breathing disorder accompanied by bradycardia, leading to endotracheal intubation, and severe bleeding of the vascular access site, resulting in blood transfusion. the mid-term complications comprised re-stenosis, chronic systemic hypertension, aneurysm formation at the angioplasty region, and aortic dissection.

The study population consisted of 26 patients with congenital coarctation of the aorta, for which they underwent aortic stenting angioplasty. there were 18 (65.4%) males and 9 (34.6%) females. Nineteen (73.1%) patients had native COA and 7 (26.9%) re-COA. Of those with re-COA, 4 had balloon angioplasty, 2 patch aortoplasty, and one end-to-end anastomosis operation.

The demographic data of the patients such as age, weight, stent size, balloon size, procedure duration, and follow-up duration were divided into native COA (Table 1) and re-COA (Table 2) groups. All the patients were prescribed heparin 50 u/kg/6hr for 24 hours, Plavix 1mg/kg/day for one month, and A. S. A 3-5 mg/kg/day for 6 months. the stents used were the Bare Cheatham Platinum (CP) stent in 13 cases, Covered CP stent in 9 cases, Max LD (EV3) stent in 3 cases, and pre-mounted Racer (Medtronic) stent in one case. the balloons utilized were BIB (numed) in 23 cases and Z-Med in 2 cases. in one patient, who had middle aortic syndrome, the pre-mounted Racer (Medtronic) stent was used.

Of the 19 cases with native COA, 8 (42.1%) patients...
developed minor early complications, consisting of 2(10.52%) cases of transient abdominal pain and 6(31.57%) cases of pulse weakening in the limb of the vascular access. The early complications, consisting of apnea, bradycardia, and severe bleeding of the procedure site necessitating intubation, blood and fresh frozen plasma transfusion, and vitamin K injection, developed in only one (5.26%) case: This was an 8-year-old, 20-kg patient with long segment COA.

Of the 7 cases with re-COA, 2(28.5%) patients developed early minor complications, consisting of transient nausea and vomiting, one patient suffered minor bleeding of the vascular access site, and one patient had urinary retention and minor bleeding of the vascular access site. There were no cases of major early complications in the re-COA patients.

During the follow-up period of the 19 cases with native COA, mild re-COA was detected in 6(31.57%) patients without need for re-intervention. The late complications such as systemic hypertension, aneurysm formation, and aortic dissection were not detected in any of the patients.

During the follow-up period of the 7 cases with re-COA, moderate re-COA was observed in 2(28.57%) patients, for whom stent re-dilation was done, and mild re-COA was seen in 3(42.85%) patients, who had no need for re-intervention. In one patient in this group, chronic systemic hypertension was detected, for which drug therapy was commenced. Aneurysm formation and aortic dissection were seen in none of the patients of this group.

**Discussion**

COA, first described by Morgagni in 1760, encompasses a wide spectrum of presentations from cardiogenic shock in the neonate to murmur and upper-limb hypertension in adults. In 1982, balloon dilation was introduced as an alternative to surgery. Stents were first used in the early 1990s to treat COA in children. Since then, balloon-expandable endovascular stents have been drawn upon successfully to handle large vessel stenoses, including COA. Angioplasty with a stent creates a ‘controlled tear’ in the aortic wall supported by the framework of the stent upon dilation, minimizing the risk of dissection or aneurysm formation, which could occur after balloon dilation alone. Studies have shown excellent results in short and intermediate follow-up, with success rates approaching 97% in selected patients.

Complications of stent placement are generally well tolerated and rarely serious. These include aortic disruption, arterial access problems, balloon rupture, stent migration, aneurysm formation, late restenosis due to intimal hypoplasia, death in 0-1.4% of cases, neurological damage in 0-3.7% of cases, stent fracture, balloon rupture, paradoxical hypertension, endocarditis, and occlusion of the major branches of the aortic arch. Stent replacement requires the application of large diameter sheaths, which creates limitations in the use of this device in pediatrics, especially in infants. To our knowledge, there is a paucity of data in the existing literature on complications in young patients, particularly those with native COA. It is also worthy of note that some studies have reported no major complications in children.

The present study was conducted in children and adolescents, most of them with native COA. The bulk of the acute complications in our study population was minor and temporary; early major complications occurred in only one of our patients. During the follow-up period of 12-56 months, while none of the native COA group patients developed late complications, in the re-COA group, 28.57%
of the patients had re-stenosis and 14.28% had chronic systemic hypertension, necessitating drug therapy. These results, in comparison with those reported by earlier studies, are noteworthy.22-25

The present study has some limitations, first and foremost amongst which is its small sample volume and insufficient follow-up duration.

Conclusion

Our investigation into the complications in patients with native COA and re-COA demonstrated that COA treatment by stent implantation could be an effective and safe method even in young patients with native COA, if selected appropriately. Availability of low profile stents and balloons affords the application of this treatment modality in low weight patients and infants. Further studies with larger populations and longer follow-up periods are required to evaluate the long-term outcome in such patients.

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References