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Most Coarctations, Recoarctations, and Coarctation-Related Aneurysms Should Be Treated Endovascularly

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Abstract

For patients with coarctation of the aorta (CoA), surgical intervention results in an overall survival rate nearly twice that of medical management. Therefore, surgical correction of CoA has traditionally been warranted in the majority of patients, even though open repair entails its own complications. With the advent of endovascular technology, many interventionalists hoped that this approach would decrease the complications associated with open surgical repair of CoA. Nevertheless, there is still an ongoing debate about the merits of traditional open surgery versus endovascular therapy. In this review, we discuss the role of these two approaches for the management of CoA, recoarctation, and coarctation-related aneurysms.

Key Words

Coarctation of aorta • Aorta • Endovascular repair • Open repair

Introduction

Coarctation of the aorta (CoA) has a wide spectrum of manifestations. The disease may be diagnosed at an early age in patients with acyanotic heart disease or may be diagnosed incidentally in adults. Because of this variability in presentation, each clinical scenario involving CoA is unique, and definitive management should be tailored individually for each patient. We propose that most CoAs, recoarctations, and CoA-related aneurysms are best treated with endovascular techniques and that surgery should be reserved for selected cases.

Open Repair versus Endovascular Surgery

Traditional open repair of CoA relies on variable techniques, including direct end-to-end repair, aortoplasty, patch repair, and interposition-graft repair. All of these operations entail the cardiovascular and respiratory risks posed by general anesthesia in addition to procedural and periprocedural complications. Many procedural complications are associated with the need for cardiopulmonary bypass and aortic cross-clamping. In addition, open repair often necessitates a median sternotomy or lateral thoracotomy incision, which can result in significant morbidity. Postoperatively, patients often have a prolonged recovery, with average hospital stays lasting longer

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than 1 week, and need physical rehabilitation. The increased morbidity and prolonged recovery usually result in greater hospital expenses.

After performing resection with extended end-to-end anastomosis for CoA in 201 patients from 1991 through 2007, Kaushal and colleagues [1], of the Children's Memorial Hospital, in Chicago, reported an early mortality rate of 2%, in addition to the following morbidity rates: septicemia, 4%; recurrent laryngeal nerve paresis, 3%; chylothorax, 3%; pulmonary hypertensive crisis, 1%; and reoperation for ventral-septal-defect closure, mediastinitis, or delayed sternal closure, 2%. Brown and associates [2], of the Mayo Clinic, reported an overall 2.4% mortality rate for 819 patients with isolated CoA who underwent primary operative repair between 1946 and 2005 by means of extended end-to-end anastomosis, patch angioplasty, interposition grafting, bypass grafting, or subclavian flap or "other" repair. Moreover, Preventza and coauthors [3], of the Texas Heart Institute, reported a 1.9% 30-day mortality rate with re-operative surgery in 53 patients with CoA-related aneurysms. In addition, these surgeons reported the following complications: vocal-cord paralysis, 20.8%; need for prolonged mechanical ventilation, 11.3%; reoperation for bleeding, 7.5%; neurologic events, 5.7%; acute renal failure, 5.7%; and need for a tracheostomy, 3.8%.

In the Quebec Native Coarctation of the Aorta Study [4], investigators retrospectively compared surgical repair to transcatheter intervention (angioplasty) in 80 patients (mean age, 12 years) treated between 1998 and 2004. Procedure-related complications were far more common in the surgical group (50%) than in the angioplasty group (18%) ($p = 0.005$). The median hospital stay was 7 days for the surgical group and 1 day for the angioplasty group ($p < 0.001$). At 38 $\pm$ 21 months, however, the rate of follow-up repeat intervention was higher in the angioplasty group (32%) than in the surgical group (0%) ($p < 0.0001$).

Proponents of open surgical repair often argue that in endovascular procedures, the short-term benefits of decreased morbidity and mortality are gained at the expense of durability and longevity, but that is not the case. Jenkins and colleagues [5] reported that most patients who undergo open repair are symptom-free for approximately 20 years after their initial operation, but 30% to 75% of these patients later have recurrent hypertension.

The direct end-to-end sutured anastomosis originally described by Crafoord and Nylin [6] in 1945 has largely been abandoned due to high rates of recoarctation, and many surgeons now perform alternative variations [7]. Kaushal and associates [1] reported a 4% reintervention rate after extended end-to-end anastomosis; three of their patients needed balloon angioplasty, and five patients required reoperation. In their study, 75% of reinterventions occurred within the first year after initial surgery. Alternatives, such as patch aortoplasty, have long been associated with high rates of aneurysmal formation (20–40%) [8]. The addition of polytetrafluoroethylene (PTFE) for aortoplasty lowered rates of aneurysmal disease but, unfortunately, increased rates of recoarctation to 25% [9].

In 2013, after analyzing surgical repairs of isolated CoAs performed in 819 patients at the Mayo Clinic over the past 60 years, Brown and colleagues [2] concluded that lifelong surveillance is mandatory after surgical repair. They reported that in comparison to age- and sex-matched populations, patients who underwent open repair had reduced long-term survival. Repair at an early age was an independent risk factor for reintervention. At 30 years' follow-up, patients who underwent an initial repair before 1 year of age had an average reintervention rate of 31.1%, and patients who underwent an initial repair before 5 years of age had an average reintervention rate of 73.3%.

Endovascular approaches have the advantage of being performed under local anesthesia with sedation, avoiding the risks of general anesthesia. In addition, these procedures can be performed completely percutaneously, avoiding the morbidities that may accompany median sternotomy or lateral thoracotomy incisions. After endovascular treatment, patients often have shorter hospital stays, avoiding many common postsurgical complications such as urinary tract infections, pneumonia, and deep venous thrombosis.

In 2011, the American College of Cardiology's Congenital Cardiovascular Interventional Study Consortium published a report that compared surgery, stenting, and balloon angioplasty for the treatment of CoA [10]. This multicenter, observational, nonrandomized study involved 350 patients from 36 institutions. Compared with surgery, stent placement appeared to produce hemodynamically equivalent results during follow-up observation. Moreover,

Table 1. Summary of selected series involving the use of stent grafts to treat native coarctation of the aorta (CoA), recurrent CoA, and CoA-associated aneurysms.

Year	First author	No. of patients	Mean age (y)	Stent type(s)	Stent model	Mean FU period (mo)	Morbidity rate (%)	Mortality rate (%)	Reintervention rate (%)
2006	Tzifa [19]	30	28	CS	Cheatham-Platinum	11	13	0	13
2007	Butera [13]	33	18	CS	Cheatham-Platinum	12	0	0	3
2008	Tanous [18]	22	39	CS	Cheatham-Platinum	12	4	0	13
2009	Botta [11]	11	45	CS	Talent/Valiant Medtronic	44	14.3	0	0
2010	Shennib [17]	22	40	BES, CS	Palmaz, Gore-TAG, Cook Zenith	31	0	0	4
2010	Bruckheimer [12]	25	—	CS	Advanta V12D	4.9	0	0	0
2012	Roselli [16]	59	38	CS, BES	Gore-TAG, Cook Zenith	56	3	0	12
2013	Preventza [3]	11	39	CS	Gore-TAG, Talent/ Captivia, Medtronic	40	0	0	0
2013	Khavandi [14]	17	39	CS	Valiant Medtronic, Cook Zenith	31	23	0	0
2014	Perera [15]	13	45	CS	Gore-TAG, Valiant Medtronic	15	0	0	7

BES = balloon expandable stent; CS = covered stent; FU = follow-up.

stenting was associated with significantly fewer complications [2.3% versus 8.1% for surgery and 9.8% for balloon angioplasty ($p < 0.001$)] and shorter hospital stays [2.4 days versus 6.4 days for surgery ($p < 0.001$)]. The reintervention rate was higher in the stent group; however, this finding was attributed to staged procedures or patient somatic growth, and all reinterventions carried a similar low risk of morbidity and mortality.

Recently, use of covered stents has been advocated for CoA, recoarctation, and CoA-related aneurysms (Table 1) [3, 11-19]. In 2009, Botta and associates [11] reported their experience using thoracic stent grafts in the treatment of CoA. They reported a 100% technical success rate, a 0% mortality rate, and a 0% reintervention rate after a mean follow-up period of 44 months. The incidence of procedural complications was 14%. Five years later, Perera and coworkers [15] reported similar rates of technical success, mortality, and reinterventions; in addition, their procedural complication rate was 0%, most likely because of increased experience and advances in technology with newer lower-profile systems. Theoretically, covered stents have the advantages of reducing the extent of the intimal tear, creating a framework for neointimal growth, and allowing control of the integrity of the aortic wall. For these reasons, they should be the standard of care for managing coexistent aneurysmal disease.

Conclusion

In patients with CoA, recoarctation, or a CoA-related aneurysm, open surgical repair is associated with an unnecessary risk of morbidity and mortality. In patients more than 1 year old, endovascular procedures have been shown to yield immediate outcomes similar to those of surgery, defined as hemodynamically controlled hypertension in the follow-up period [4]. Any argument regarding endovascular reintervention, however negligible, is formidable, because such reintervention is associated with the same risks of morbidity and mortality as the initial operation [11]. Furthermore, belief in the longevity of surgical repair

for CoA is erroneous, as a large percentage of these repairs are plagued with recoarctation and CoA-related aneurysms [5]. Unfortunately, reoperative surgery in these patients entails increased risks of morbidity and mortality [3].

With the application of endovascular surgery to CoA, interventionalists have gained a new armamentarium for addressing this condition. Both interventions and reinterventions are associated with low risks of morbidity and mortality. As technology continues to evolve, the role of endovascular surgery will be further defined, clearly demonstrating that this approach is optimal for managing the majority of CoA and finally silencing this debate.

Conflict of Interest

The authors have no conflicts of interest relevant to this publication.

Comment on this Article or Ask a Question

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