Coronary artery bypass in infants with left main coronary artery atresia using an internal thoracic artery bypass graft

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Left main coronary atresia (LMCA) is a rare condition that presents at any age. Patients present with sudden death, myocardial ischemia, and heart failure (HF) from mitral valve (MV) insufficiency (MI). In a review of 96 reported patients in the world literature, 50 are pediatric and, of those, very few are infants.1 In adults, revascularization is recommended, as sudden death is common in untreated patients.1,2 Left main coronary artery (LCA) osteoplasty is the preferred treatment for this condition in children; however, of 39 reported pediatric surgeries, there were 4 deaths and several revision surgeries. One infant internal thoracic artery (ITA) bypass graft was reported in 2020 with 3 childhood patients,3 and 8 ITA grafts were reported in children from 2.5 years to 15 years in 2018.4 There is scarcity of reports of using ITA graft in treatment LMCA in infants.

We performed coronary artery bypass grafting using ITA-to-left anterior descending (LAD) anastomosis in 3 infants with LMCA at the Southampton General Hospital in England and Helen DeVos Children’s Hospital in Michigan over a 14-year period (2008-2022), and the patency of the graft has been confirmed in each patient. Institutional review board 2021-496 was approved on November 23, 2021.

CENTRAL MESSAGE
Internal thoracic artery bypass graft is a reliable long-term solution for infants presenting with left coronary artery atresia when performed by surgeons experienced in this procedure in infants.

CASE REPORTS
Patient 1 was a 6-week-old girl who presented with HF; echocardiography showed severe MI, infarcted papillary muscles (PMS), and no connection of the LCA to the aorta. The diagnosis of LMCA was confirmed by angiography with complete backfilling of the left system. ITA graft to mid-LAD and MV repair were performed. Recovery was uneventful, and a repeat angiogram was performed 1 year following surgery. At 14 years of age, she remains asymptomatic, and a recent magnetic resonance angiography confirms very brisk coronary flow down the ITA with graft elongation and no distortion (Figure 1). Echocardiography confirms normal left ventricular (LV) size and function with mild MI.

Patient 2 was a 7-week-old boy who presented to the emergency department with HF, severe ventricular dysfunction, and MI. LMCA was diagnosed on echocardiography and confirmed by catheterization. The child underwent ITA graft and concomitant MV repair. Despite an
unremarkable recovery with mild-to-moderate MI, PMs dysfunction progressed, and repeat mitral repair was required 3 months following initial surgery. Recovery was uneventful, and the patient was discharged with mild MI. Angiography 1 year following surgery confirmed excellent flow and growth of the ITA (Figure 2). At 8-year follow-up, the patient is asymptomatic with normal LV function and mild stable MI.

Patient 3 was a 9-month-old girl who presented with an incidental murmur. A screening echocardiogram failed to identify a connection of the LCA to the aorta. Despite preserved ventricular function, there were early signs of echocardiographic brightness in the tips of both PMs and mild MI. LMCA was suspected and confirmed by computed tomography angiography. ITA graft to LAD graft was performed (Video 1), and she made a rapid recovery from the surgery. Immediate patency of the graft was confirmed by computed tomography angiography before discharge (Figure 3). She remains asymptomatic at 1-year postsurgery and echocardiography confirmed normal LV function with no MI.

DISCUSSION

LCA osteoplasty is generally recommended to reconnect the left mainstem with the aorta in infants. Long-term patency depends on growth of the connection, as well as lack of inflammation and scarring within the patched

FIGURE 1. Magnetic resonance angiography of patient 1 at 14 years after surgery showing very brisk flow down the internal thoracic artery bypass graft to the left coronary artery with graft elongation and no distortion.

FIGURE 2. Transcatheter angiography 1 year after surgery showing excellent flow and growth of the internal thoracic artery graft in patient 2.

FIGURE 3. 3D reconstruction of computed tomography angiography of patient 3 showing patency of the graft 3 days postoperatively. ITA, Internal thoracic artery; LAD, left anterior descending artery; LCX, left circumflex; RCA, right coronary artery.
hood of the connection. The largest series of LCA osteoplas-
ysis is from Ma and colleagues, who reported no stenosis in
the 8 surviving patients of 9 total; however, the median follow-up was only 10.9 months. This author has successful
experience with internal thoracic artery bypass graft in
infants and children with different etiologies where osteo-
plasty was not an option.

In this rare condition, it is not possible to have conclusive
data on the long-term efficacy of a surgical strategy; howev-
er, the 13-year follow-up in patient 1 is encouraging, and the
evidence from adult literature on long-term ITA patency
would suggest that it is an excellent option in infants with
this rare disease.

All our patients presented in infancy with varying de-
grees of HF and MV pathology. All 3 were treated with
an ITA-to-LAD graft, and 2 required concomitant MV
repair. They have maintained excellent anatomic and func-
tional status, with proven growth and patency of the ITA
graft in early, mid-, and late follow-up.

We present evidence that initially successful ITA graft is
a reliable long-term solution for infants presenting with
LMCA when performed by surgeons experienced in this
procedure and comfortable in performing it in infants and
neonates. In addition, it appears that repair of the MV in in-
fants in this condition, if performed early in the disease pro-
cess, is durable.

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References
1. Alsalehi M, Jeewa A, Wan A, Contreras J, Yoo SJ, Laks JA. A case series of left
main coronary artery ostial atresia and a review of the literature. Congenit Heart
Dis. 2019;14:901-23. https://doi.org/10.1111/chd.12842
2. Barron DJ, Guariento A. Novel observations and approaches for left main coron-
ary artery atresia: how do we learn to manage an incredibly rare condition?
Can J Cardiol. 2021;37:827-9. https://doi.org/10.1016/j.cjca.2020.11.009
3. Kreutzer C, Bastianelli G, Chiostri B, Gutierrez G, Klinger DA, Vaccarino G.
CABG with internal thoracic artery in children with congenital heart defects: a
good option when it is the only one. World J Pediatr Congenit Heart Surg. 2020;11:748-52.
https://doi.org/10.1016/j.wjchs.2020.04.015
4. Arnaz A, Sarioglu T, Yalcinbas Y, Erek E, Turkoz R, Oktay A, et al. Coronary ar-
tery bypass grafting in children. J Card Surg. 2018;33:29-34. https://doi.org/10.1111/jocs.13510
5. Ma K, Qi L, Yuan J, Zhang B, Yuan X, Fan T, et al. Anatomic repair of left main
coronary artery atresia: coronary ostioplasty with autologous pulmonary artery.
Can J Cardiol. 2021;37:887-94. https://doi.org/10.1016/j.cjca.2020.10.012