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Arterial reconstructions for pediatric splanchnic artery occlusive disease

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ABSTRACT

Objective: Pediatric splanchnic arterial occlusive disease is uncommon and a rare cause of clinically relevant intestinal ischemia. This study was undertaken to better define the clinical manifestations and appropriate treatment of celiac artery (CA) and superior mesenteric artery (SMA) occlusive disease in children.

Methods: Clinical courses of 30 consecutive children undergoing operations for splanchnic arterial occlusive disease at the University of Michigan from 1992 to 2017 were retrospectively analyzed.

Results: Vascular reconstructions were performed for splanchnic arterial disease in 18 boys and 12 girls, 1.5 to 16 years of age (mean, 7.5 ± 4.1 years). Isolated splanchnic arterial disease was uncommon (2 children), being more often associated with abdominal aortic coarctations (19 children) or ostial renal artery stenoses (25 children). Primary splanchnic arterial reconstructions (30) included aortic reimplantation of SMAs (15) or celiacomesenteric arteries (2), aortoceliac and aortomesenteric bypasses (7), reimplantation of the CA as a patch over the stenotic SMA orifice (3), and patch angioplasty of the CA (2) or SMA (1). There was no perioperative mortality. Two groups (I and II) were identified for study. Group I children (14) experienced symptomatic intestinal ischemia, manifested by various combinations of chronic postprandial abdominal discomfort (14), ischemia-related intestinal bleeding (2), or failure to thrive (4). Four children in group I became symptomatic after known CA and SMA occlusive disease was left untreated at the time they underwent earlier interventions for renovascular hypertension. Seven secondary redo interventions were undertaken for recurrent symptoms in six group I children. Only one major periprocedural complication occurred: segmental colon infarction. The assisted patency rate of reconstructed arteries in group I children was 93%, and intestinal ischemic symptoms resolved in every child. Group I follow-up from the most recent splanchnic arterial reconstruction averaged 4.3 years. Group II children (16) without manifestations of intestinal ischemia underwent prophylactic splanchnic arterial reconstructions in concert with combined aortic and renal artery procedures (11), isolated abdominal aortic reconstructions (3), or renal artery reconstructions alone (2). Group II children experienced no major perioperative morbidity and remained asymptomatic postoperatively, and none required secondary splanchnic artery interventions. Group II follow-up averaged 7.4 years.

Conclusions: Pediatric splanchnic artery occlusive lesions are often associated with developmental aortic and renal artery occlusive disease. Carefully conducted therapeutic and prophylactic reconstructive procedures are appropriate in children having splanchnic arterial occlusive disease. (J Vasc Surg 2018;■:1-9.)

Occlusive disease of the celiac artery (CA) and superior mesenteric artery (SMA) in children is uncommon and a rare cause of clinically relevant intestinal ischemia. Nevertheless, splanchnic arterial reconstructions are necessary in some children who are symptomatic and may be appropriate in select asymptomatic children who are at potential risk for development of later manifestations of intestinal ischemia. Unfortunately, definitive treatment algorithms regarding childhood splanchnic arterial occlusive disease are nonexistent. The purpose of this study was to review a large experience with the operative management of pediatric CA and SMA occlusive disease at the University of Michigan in an effort to better define the indications for surgical intervention and expected outcomes in these children.

METHODS

The medical records of all pediatric patients (18 years or younger) who underwent splanchnic arterial reconstructive procedures at the University of Michigan from 1992 to 2017 were reviewed. Excluded from study were three children undergoing splanchnic vascular procedures coincident with operations for abdominal aortic aneurysms[1] and two individuals treated for splanchnic artery aneurysms,[2] all of whom were described in earlier publications. Two symptomatic and eight asymptomatic children with CA and SMA

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occlusive disease were included in a 2002 report from the authors' institution.[3]

Patients were categorized by age, clinical manifestation, operative interventions undertaken, and surgical outcomes. The preoperative and postoperative status was ascertained in all patients. Two groups of children were identified for study: children with symptoms of intestinal ischemia (group I) and those having asymptomatic CA or SMA occlusive lesions (group II).

Cumulative data are presented as the mean ± 1 standard deviation and subjected to paired *t*-test and χ^2 analyses when appropriate. This retrospective review was approved by the Institutional Review Board at the University of Michigan (HUM0006223), and a waiver of informed consent was granted.

ARTICLE HIGHLIGHTS

- **Type of Research:** Single-center retrospective cohort study
- **Take Home Message:** Arterial reconstruction of the splanchnic arteries in 30 pediatric patients between the ages of 1.5 and 16 years performed by a variety of techniques resulted in no mortality, assisted primary patency of >90%, and symptomatic relief in all. Seven patients required reoperation for recurrent symptoms.
- **Recommendation:** This study documents excellent outcomes of pediatric splanchnic reconstructions at a center of excellence.

Clinical experience

Thirty children ranging in age from 1.5 to 16 years (mean, 7.5 ± 4.1 years) underwent operative interventions for splanchnic arterial occlusive disease at the University of Michigan during the study period. Included were 18 boys and 12 girls. The mean ages of children who were symptomatic (6.6 years) and those who were asymptomatic (8.3 years) were not statistically different ($P = .68$). All splanchnic artery occlusions or stenoses in this experience were ostial in location, with narrowings occurring within 1.5 cm of the proximal artery's origin. The histologic character typical of these narrowings included diminutive lumens, excessive and irregular intimal thickenings, fragmentation of the elastic lamina, discontinuous media, and increases in perimedial elastic tissue (Fig 1).

Presentation. Group I included 14 children who had symptoms attributed to insufficient intestinal blood flow (Tables I and II), manifested by various combinations of postprandial abdominal discomfort (14), failure to thrive (4), and intestinal bleeding associated with ischemic colitis (1) or ischemic gastritis with ulcerations (1). Both sexes were equally affected among group I children (seven boys, seven girls). Two group I children had clinical manifestations of intestinal ischemia with no concomitant aortic or renal artery disease; the remaining 12 children experienced severe renovascular hypertension in addition to their symptomatic intestinal ischemia. Four children in group I were known to have had untreated asymptomatic CA and SMA occlusive disease at the time they underwent earlier successful renal or aortic operations for renovascular hypertension. These four cases represent 6.8% of 59 children encountered during the current report's 25-year study period who had recognized but untreated splanchnic arterial occlusive disease at the time they underwent earlier interventions for renovascular hypertension (unpublished data from the authors' institution). In one of these children, her postoperative blood pressures normalized but at the expense of further reductions in the intestinal blood flow, causing symptomatic intestinal ischemia in the early postoperative period. This necessitated a splanchnic arterial reconstruction 2 months after her renal artery reconstruction.

Group II included 16 children who were asymptomatic in regard to their anatomic CA or SMA occlusive disease (Table III). There was a male predominance among the group II children (11 boys, 5 girls). Prophylactic splanchnic arterial revascularizations were performed when critical CA or SMA stenoses or occlusions existed close to the aortic or renal artery reconstructions. These included combined reconstructions of the aorta and renal arteries (11), the renal arteries alone (2), or only the aorta (3).

Diagnosis. Preoperative conventional arteriography, usually intra-arterial digital subtraction angiography (IADSA), established the anatomic presence of splanchnic arterial disease in 18 children (Fig 2), including 12 children who also had computed tomography angiography (CTA) or magnetic resonance angiography (MRA) performed in addition to the confirmatory arteriography. CTA or MRA studies were undertaken as the only diagnostic tool in one child each.

Imaging confirmed CA stenoses (18) or occlusions (8), SMA stenoses (24) or occlusion (1), and celiacomesenteric trunk (CMT) stenoses (2). Only one child presented with concomitant CA and SMA occlusions. The inferior mesenteric artery (IMA) was usually dilated as a consequence of its being the principal collateral vessel to the foregut and midgut structures. The IMA was stenotic at its origin in only 2 of the series' 30 children. In every instance, the CA, SMA, and IMA narrowings ranged from 2 to 4 mm in length.

During the course of this experience, the authors have favored MRA studies for splanchnic arterial occlusive disease screening, recognizing that MRA false positives may exist because of phase dropout accompanying turbulent flow through noncritical stenoses. Nevertheless, normal findings on MRA exclude the existence of an important CA or SMA narrowing. CTA was often obtained by the referring physicians before a child's being admitted to the authors' institution, but because of the potential