aortic growth, these findings help inform an understanding of the relationship between late aortic anatomy and exercise performance in patients with repaired coarctation.

Reference

1. Mandell JG, Loke YH, Mass PN, Opfermann J, Cleveland V, Aslan S, et al. Aorta size mismatch predicts decreased exercise capacity in patients with successfully repaired coarctation of the aorta. *J Thorac Cardiovasc Surg.* 2021;162:183-92.e2.

See Article page 183.

Check for updates

Commentary: Exercise capacity after coarctation repair: When size finally matters!

Sameh M. Said, MBBCh, MD, FACS

Aortic coarctation is a life-long problem that unlike many other congenital heart defects does not end by its repair, even if it is successful, and even if it is done early in life. Data suggest these patients remain at risk of increased mortality¹ and morbidity.² The study of exercise intolerance and the hypertensive response to exercise after coarctation repair has gained wide popularity in recent years.³

I read with interest the study by Mandell and colleagues,⁴ where the authors evaluated aortic size mismatch (ascending-to-descending aortic diameter ratio, D_{AAo}/D_{DAo}) and its impact on exercise capacity after coarctation repair. The authors used several aortic measurements (diameter, arch height-to-diameter ratio) and percent descending aorta (% D_{Ao}) flow from cardiac magnetic resonance imaging and exercise stress testing in 15 patients who underwent successful coarctation repair. They also generated mock circulatory flow loops with the help of printed 3-dimensional models of the aortae. They identified that aortic size mismatch and ratio of % D_{Ao} flow in exercise-to-rest negatively correlated with oxygen consumption.

Sameh M. Said, MBBCh, MD, FACS

CENTRAL MESSAGE

Exercise capacity after coarctation repair is not only affected by residual gradient; other factors that control fluid dynamics, such as aortic size mismatch and arch geometry, may play a role.

These findings beg the following interesting and practical questions:

1. How to define success after coarctation repair? It looks like it is not just the mere absence of a gradient anymore.
2. What is the optimal repair technique? Native tissue-to-native tissue with no prosthetic material? Now, we do not know if this will be sufficient to preserve normal geometry. Proponents of direct end-to-end or extended end-to-end repair may need a second look. Maybe it is better to have normal arch geometry with added patch material to minimize tension and maintain normal flow dynamics rather than focusing on avoiding it. And if we will use a patch, what type?
3. What is a significant gradient means? Are we delaying interventions because of random numbers?
4. In absence of significant gradient, will geometry and size mismatch be the only factors that affect exercise capacity in these patients? How about wall stiffness? I think

From the Division of Pediatric Cardiovascular Surgery, Masonic Children's Hospital, University of Minnesota, Minneapolis, Minn.

Disclosures: Dr Said reported consultant for CryoLife.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication Nov 1, 2020; revisions received Nov 1, 2020; accepted for publication Nov 2, 2020; available ahead of print Nov 7, 2020.

Address for reprints: Sameh M. Said, MBBCh, MD, FACS, Division of Pediatric Cardiovascular Surgery, Department of Surgery, Masonic Children's Hospital, University of Minnesota, 2450 Riverside Ave S, East Building, MB 539, Minneapolis, MN 55454 (E-mail: ssaid@umn.edu).

J Thorac Cardiovasc Surg 2021;162:194-5

0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2020.11.007>

we need to study all the components of the Hagen–Poiseuille equation.⁵

5. How can we use this information in current practice? And can we apply the same perspectives in other congenital heart defects that require arch interventions: hypoplastic left heart syndrome, interrupted aortic arch, etc.
6. And finally, how about the future? Is it possible that one day we can use these data to design custom-made vascular grafts that will achieve the best arch geometry and eliminates any anastomotic gradient? I believe we are not far from this.

It is also important to notice the following drawbacks:

1. The majority of patients in the current study are adults (only 2 children). The age at primary repair varied, but it was done in the neonatal period in 3 patients only.
2. Different repair techniques have been described with almost 40% to 50% rate of recurrence requiring a second intervention. We do not know if these data will apply to those with recurrent coarctation.
3. The method of measuring the D_{AAO}/D_{DAO} is not validated in pediatric patients. The use of ($\%D_{AO}$) flow seems to be more physiologically relevant, as it is probably more

reflective of the aortic arch resistance, but it also depends on other variables that were not evaluated, such as systemic vascular resistance and arterial compliance.

4. A larger number of patients is definitely needed to further validate these findings and determine its applicability.

It seems like the coarctation saga is not over yet, and there are a lot of work that needs to be done to identify the proper treatment strategy for those patients, identify the proper timing of intervention, and properly evaluate outcomes.

References

1. Vriend JWJ, Mulder BJM. Late complications in patients after repair of aortic coarctation: implications for management. *Int J Cardiol*. 2005;101:399-406.
2. Pickard SS, Gauvreau K, Gurvitz M, Gagne JJ, Opatowsky AR, Jenkins KJ, et al. Stroke in adults with coarctation of the aorta: a national population-based study. *J Am Heart Assoc*. 2018;7:e009072.
3. Yogeswaran V, Connolly HM, Al-Otaibi M, Ammash NM, Warnes CA, Said SM, et al. Prognostic role of hypertensive response to exercise in patients with repaired coarctation of aorta. *Can J Cardiol*. 2018;34:676-82.
4. Mandell JG, Loke YH, Mass PN, Opfermann J, Cleveland V, Aslan S, et al. Aorta size mismatch predicts decreased exercise capacity in patients with successfully repaired coarctation of the aorta. *J Thorac Cardiovasc Surg*. 2021;162:183-92.e2.
5. Pfitzner J. Poiseuille and his law. *Anesthesia*. 1976;31:273-5.