

EDITORIAL

Reshaping the Evidence for Surgical Correction of Pectus Excavatum Using Cardiopulmonary Exercise Testing

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Pectus excavatum is the most encountered chest wall deformity¹ yet there is ongoing debate as to the physiological and cardiopulmonary impact of this disease and significantly if surgical repair may offer benefit to patients.² In the United Kingdom, the controversy around the physiological and psychological impact of pectus deformities led the National Health Service to decommission (not for routine) pectus surgery treatment.³ This judgment has had far-reaching and significant effects and led to questions being asked in the Houses of Parliament as well as formal review of the policy (*decision pending*).

See Article by Jaroszewski et al.

There have been 275 papers published in the past 10 years on “functional” changes before and after corrective pectus surgery. Many of those papers are small cohort and retrospective case series^{4–6} and are, as reflected by National Health Service’s decision in the United Kingdom, heterogenous in nature and quality of evidence presented.

In this issue of the *Journal of the American Heart Association (JAHA)*, new work by Jaroszewski et al.⁷ investigates using cardiopulmonary exercise testing (CPET), the cardio-respiratory effects of minimally invasive “Nuss” surgical repair (MIRPE).

A prior study by the same group using transesophageal echocardiography following pectus repair demonstrated immediate and significant improvements in anatomic and functional cardiac parameters (including right and left ventricular dimensions, stroke volume, and speckle tracking strain).⁸ Indeed, the authors previously published a detailed review paper summarizing the available literature on cardiopulmonary outcomes along with quality of life and patient satisfaction after pectus excavatum repair.⁹

Among surgeons it is clearly recognized that although subjective improvement in exercise tolerance is often reported by patients following MIRPE,¹⁰ few studies have robustly investigated this potentially functional benefit, especially in such a large cohort of patients, taking into consideration physiological parameters as opposed to anatomic assessment.¹¹

The authors in the current issue share the findings performed from a retrospective study among patients operated between 2011 and 2020 and identified 392 undergoing CPET before MIRPE of whom 68% had abnormal peak oxygen consumption. Of these, 130 patients also underwent CPET immediately before bar removal at a mean time interval of 3.4 years post repair with a significant demonstrable improvement in outcomes including peak VO_2 , oxygen consumption at anaerobic threshold, and maximal ventilation. In a small subgroup of 39 patients with available pre- and

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postrepair transesophageal echocardiography studies of the right heart, improvement in stroke volume was also demonstrated. Notably, there was also an improvement in patients with normal baseline cardiopulmonary function and without severe anatomical defects. No significant association was found in a univariate analysis between the improvement in VO_2 max and anatomical variables such as Haller Index, sternal tilt, or cardiac compression index.

When trying to generalize the findings, it is important to note that all operations were performed by a single, high-volume surgeon experienced in repair of adult pectus excavatum. A 2-bar technique was used in 69% of patients and 3-bar in 31% with an average age of 30 years old. The average age is interesting in that it certainly reflects the “adult” nature of the practice presented as most published studies^{12,13} on MIRPE are in a younger age group. The retrospective nature of this study also meant that 78 patients (78/262, 29.78%) during the study period declined postoperative CPET evaluation (before bar removal) for personal reasons, particularly during the COVID-19 surge, when they did not want to prolong hospital admission. Moreover, at the end of the current study period, of the 262 patients without a postoperative CPET, the bar removal procedure had not yet been performed for 184 cases (184/262, 70.22%).

Despite most patients being symptomatic before surgery, the authors in the study were unable to perform a formal, objective survey of changes to patient symptoms before bar removal, which could have supported further the reported improvement in CPET outcomes. We therefore look forward to the authors sharing their mid- and long-term outcomes related to symptoms in patients with upcoming CPET testing as well as those who have had bars removed and are willing to have repeat CPET testing at 6 months to 1 year post bar removal. And particularly because following bar removal, 10% to 15% of patients with pectus excavatum can have recurrence, it would be interesting to therefore evaluate the physiological impact based on CPET in this group.

Overall, the authors should be congratulated for conducting this study in such a large number of patients. Following the take-up of MIRPE by the surgical community, early work investigated changes to lung function (spirometry), oxygen pulse, and incremental exercise testing but in small patient cohorts.¹⁴ Further assessment of cardiac function based on echocardiography¹⁵ or imaging¹⁶ (cardiovascular magnetic resonance) have also been reported in patients undergoing corrective pectus surgery, but again the number of patients is small, whereas there are other reported studies that have shown improvement in cardiopulmonary response.¹⁷

Pectus excavatum is too often viewed as a cosmetic disorder with a known associated psychological

impact^{18–20} but no definitive physiological measures that are reproducibly found to show that surgery can be of benefit.

As the authors of the study point out, this can affect the ability of patients to obtain insurance coverage to undergo surgical correction. In publicly funded health care systems such as the UK National Health Service, a cited lack of evidence that MIRPE can improve cardiopulmonary outcomes has resulted in the withdrawal of this treatment for patients. This timely and very interesting study provides support for the surgical correction of pectus excavatum and future studies are sought by clinicians involved in the care of this patient population.

ARTICLE INFORMATION

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Disclosures

None.

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