Pectus excavatum repair improves cardiovascular function at maximal exercise by facilitating heart filling

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The recent article by Tang et al. [1] supports the idea that Nuss repair improves cardiopulmonary exercise function in teenagers with moderate-to-severe pectus excavatum (PEx). We would like to congratulate the authors for this study and emphasize the relevance of this research, as well as their results, by making some brief remarks.

First, the authors circumvented the difficulties in measuring cardiac output during exercise by using a gas-rebreathing technique, which has been previously validated in exercise testing conditions [2]. The authors demonstrated that Nuss-operated teenagers significantly increased their cardiac index at submaximal exercise. Postoperative increase of maximum exercise cardiac index was attributed in this study to enlargement of the thoracic dimension in the anterior–posterior plane facilitating heart filling and/or their better aerobic fitness due to increased physical activity.

Second, Tang et al. [1] mentioned some of the study limitations, including the influence of growth and changes in sport habits on maximal exercise capacity. We feel that another important issue may be the misinterpretation of the relationship between cardiac performance and exercise limitation. Indeed, in healthy individuals, exercise tolerance is limited by the cardiovascular response and the degree of physical fitness, whereas no ventilation limitation is typically achieved [3]. In this setting, cardiac output is thus driven by oxygen demand, which increases with peripheral muscular exercise. In the Tang et al. study, teenagers experienced no changes in maximum oxygen uptake after Nuss repair, whereas cardiac output increased, which was mainly the result of increased maximal heart rate. One could interpret these findings as evidence of cardiovascular maladaptation, i.e. tachycardia, due to postoperative deconditioning.

In a recent study [4], we confirm that PEx open repair [5] also can beneficially impact maximal exercise capacity in young adults. Although we did not directly measure the cardiac index, our results suggested that improved aerobic capacity was accompanied by increased oxygen pulse, a surrogate of stroke volume.

We speculated that better postoperative aerobic capacity was directly related to improved haemodynamic conditions because such improvements were also observed in a series of athletes who experienced long-term, constant and heavy training protocols before and after PEx repair.

Mechanisms by which cardiovascular function improves after PEx repair remain elusive. Normalization of thoracic geometry by PEx surgery can restore the adequate development of negative pulmonary pressure that is necessary to enhance venous return, heart filling and cardiac output. Consistently, we recently demonstrated that PEx repair improved the capacity of the inspiratory muscle system to generate intrathoracic negative pressure [6]. We speculated that postoperative increased respiratory pump efficacy to generate negative pulmonary pressure and to enhance venous return facilitates better cardiovascular adaptation at maximal exercise.

REFERENCES