you think is the biggest difference between the groups? Why is there no difference in improvement?

Dr Udholm: Well, our study didn’t really come up with the answer to that question, but a theory could be that...

Dr Schmid: Interpretation.

Dr Udholm: Yes, yes. Well, one explanation could be that the older patient could be stiffer in the tissue and they simply need more time to adapt to the new chest wall.

Dr Schmid: You mentioned in the last sentence that the bar is still in place. Do you think this has an impact?

Dr Udholm: Well, the bar is still in place after 1 year with the adolescents, and we still saw improvement there. Perhaps it could have some influence, but I don’t know.

Dr Schmid: The second question is, why do you measure forced expiratory volume in the first second? Why do you think there is a difference in forced expiratory volume in the first second when you measure lung volumes and not total lung capacity or residual volume?

Dr Udholm: Well, one of the reasons why it was important for us was because we found this difference in the adolescents in the forced expiratory volume in the first second. Regarding the smokers, the proportion of smokers preoperatively was the same postoperatively.

Dr Schmid: You also mentioned what we all experience in the clinic, that they showed a subjective improvement. Why do you think there is this discrepancy between subjective improvement and your measurements?

Dr Udholm: Well, that’s a good question, because almost all of our patients still have this subjective feeling that their cardiopulmonary function is better, that they can do much more exercise than they could before, but I don’t know why they feel like this when we don’t have the data to back it up.

Dr Schmid: Also in your paper you state that the rate of exercise they do was the same before and after, so it’s not their exercise performance.

Dr Udholm: They don’t exercise more, no.

Dr Schmid: But they feel better when they exercise.

Dr Udholm: They feel better, yes, exactly.

Dr Schmid: You measured VO₂ max and you showed, and this was quite impressive, a decrease in VO₂ max in some patients. How do you explain the decrease? Is this pain-related?

Dr Udholm: Well, after one year, most of the patients don’t feel any postoperative pain anymore, but some patients did feel like they had a lot of time to getting back to exercising, because they had one month on the couch, or even more. Perhaps that could explain why some even have a decrease.

Dr Schmid: Finally, the last question, in these adult patients, shouldn’t you correlate the exercise capacity with the Haller index you corrected; in other words, that you should normalise the amount of improvement you show clinically with the exercise capacity?

Dr Udholm: Well, of course, that would have been a very good idea to have a Haller index prior to surgery to see how deep the pectus was and see if that has any influence on the data, but we didn’t.

Dr Schmid: Thank you very much.

Dr H. Pilegaard [Aarhus, Denmark]: I just have a comment on the Haller index. We tried to relate it to the depth of the excavation.

Dr Schmid: The improvement of the Haller index, but maybe in the adults.

Dr Pilegaard: No, we had a normal Haller index when we saw the young patients, the adolescents. That study we did. I can’t remember the numbers in this study. But they were normalised in the first study we did and published. They had a normal Haller index after surgery.

Dr Schmid: After surgery, all of them?

Dr Pilegaard: All of them.

Dr Schmid: I’m sorry.

Dr J. De Campos [Sao Paulo, Brazil]: Congratulations on your paper and the presentation, and we are very anxious to know the final results when you remove the bar. I have two questions for you. First, these adult patients, maybe they have 1, 2, or more bars and it’s only 1 year after. Maybe this could be one explanation, because until now, you don’t have more capacity or something like that. You have at least 2 or 3 bars here in the chest wall.

Second, the way of life of these young adolescents, they change completely. Maybe this also can explain the difference. As Professor Schmid said, I don’t know if all these adult patients are doing more exercises or not or if you have some program that tries to push them to do more exercises. How do you explain this?

Dr Udholm: For the last question, we don’t have a program to push them to do more exercise. Regarding the way of life of the adolescents and the adults, that was why we compared them with the healthy age-matched controls, and we had these questionnaires about their exercise capacity to make sure that this wasn’t the explanation, that it was simply because they were doing more exercise at the 1-year and 3-year follow-up, because this was actually completely the same, and this patient group, actually a lot of them were really active postoperatively because many of them thought that this was the explanation why they couldn’t do what they thought that they needed to do, so they were really anxious to get out there afterwards.

Dr H. Elsayed [Cairo, Egypt]: Can you just tell me how this would influence your practice in an adult patient who is not that concerned about the cosmetic effect and he has a mild to moderate pectus excavatum and you have not shown any physiological benefit? Is your study going to influence what you are going to tell him as to whether or not he should or should not have an operation?

Dr Udholm: Well, perhaps it would be best for Hans to answer that question.

Dr H. Pilegaard [Aarhus, Denmark]: I think we have to wait for the results after 3 years because they might change. There was a trend that they were better, and we hear from the patients that they feel better, most of them. You said it’s not for the cosmetic reason. I think most of these patients with pectus excavatum are coming for the cosmetic reason in Denmark, even the old.

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In teenagers, the Nuss procedure for pectus excavatum (PEx) repair has the potential to improve lung function and normalize aerobic performance during incremental exercise testing. In a cohort of 70 adults, we have previously observed that aerobic capacity significantly improved one year after the Ravitch-type procedure [1]. In sharp contrast, Udholm et al. failed to demonstrate such improvements at the one-year follow-up in 15 adults undergoing the Nuss procedure [2]. Whether these contrasting results rely on different surgical approaches will be answered in the future by the 3-year follow-up proposed by Udholm et al. Meanwhile, interesting methodological issues mentioned by Udholm et al. deserve additional comments.

First, Udholm et al.’s observed increases in postoperative peak VO₂ that were consistent with our previous reports [1,3]. Study by Udholm et al. was underpowered, precluding any definite conclusion. Surprisingly, exercise testing was performed using a 30 Watt-increment to progressively increase workload. Of note, although VO₂ max is linearly related to workload, high workload increments require sufficient time for VO₂ kinetics to increase as well. This time delay can induce an oxygen debt limiting peak VO₂ at the latest exercise steps. Absence of difference between pre- and postoperative peak VO₂ in Udholm et al.’s study may be related, at least in part, to blunted VO₂ kinetics. In order to limit confounding effects of reduced VO₂ kinetics, determination of VO₂ at ventilatory threshold and oxygen uptake efficiency slope may be useful to better characterize cardiopulmonary functional reserve in the context of symptom-limited submaximal exercise.

Secondly, authors claimed that exercise habit was similar before and after surgical correction. Exercise habits were evaluated with scoring system for categories, comparisons of which should be analysed using the Chi-2 trend rather than comparisons of means. Expression of postoperative VO₂ changes according to individual fitness category could be informative as well. As suggested by Udholm et al., changes in exercise habit may be considered a confounding effect of PEx repair on postoperative peak VO₂. Alternatively, it can be considered an expected result of PEx repair that has improved patients’ self-image and his motivation for social activities, including sports. Hence, beneficial impact of PEx repair on aerobic capacity may be related to direct improvement of cardiopulmonary response to exercise and through postoperative increases in exercise training, which will improve patient’s quality of life and reduce risk of premature mortality.

Overall, Udholm et al. have provided useful information on the 1-year follow-up after Nuss procedure in patients with PEx regarding changes in aerobic capacity. We feel that a standardized exercise testing protocol represents the most important issue that will allow study comparisons for evaluation of different procedures for PEx repair in adults.
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References

