Cardiac output measurement during maximal exercise test in patients with tetralogy of fallot (TOF) demonstrates chronotropic incompetence as a major cause of limited exercise capacity

Dept. Pediatric Cardiology, Ghent University Hospital, Belgium (1); Dept. Cardiac Surgery, Ghent University Hospital, Belgium (2)

Introduction: After repair of Tetralogy of Fallot a decreased exercise performance has been described. Cardiac output (CO) measurement during exercise testing is possible via a CO2-rebreathing technique. The aim of our study is to evaluate CO at rest and at maximal exercise in patients with TOF.

Methods: Children with corrected TOF (6-16 yrs) were invited to participate in a prospective study including a maximal cycle exercise test with spirometry combined with measurement of CO via the Oxycon Pro (Jaeger) system. Our institutional protocol (continuous ramping at 4W/kg) was applied. CO was measured at start and 20 seconds after maximal exercise performance. Data were compared with children referred for innocent complaints (chest pain) who performed a normal exercise test during the investigation period.

Results: 34 patients (18 boys) with TOF were included and compared to 36 normal exercise tests (19 boys). Groups were matched for gender, age, weight and length; BSA was equal. The duration of the exercise test was significantly shorter in the TOF-group (9.4±2.3min vs 11.7±3.3min, P<0.05). Maximal heart rate (HRmax) (177±17bpm vs 188±10bpm), maximal load (95±36W vs 118±51W ) and V02 max/kg (38.9±7.8ml/kg/min vs 47.7±10.2ml/kg/min) was significantly lower in the TOF group (all P<0.05). 57.6% of patients reached anaerobic treshold (AT), which is not different from the control group (55.6%). HR at AT was significantly lower in the TOF group (164±18bpm vs 175±15bpm, P<0.05). VE/VCO2 slope was equal in both groups. At rest, investigation of cardiac output showed no difference in Cardiac Index (CI) and stroke volume (SV). At maximal exercise, CI was significantly lower in TOF-patients (10.2±1.6 vs 11.1±1.7, P<0.05) whereas SV stayed equal (61±11ml versus 66±10ml) in both groups.

Conclusion: Patients with TOF have significantly lower oxygen consumption, HRmax, duration and load of maximal exercise test. This is consistent with earlier published data. CO measurement via the CO2-rebreathing technique, demonstrates significant difference in CI at maximal exercise, SV however remains equal. This finding, in association with significant lower HR at AT, is in support for chronotropic incompetence being a major factor of exercise intolerance in TOF patients.