Coronary arteries and aortic arch vessels in long-term active ultra-marathon runners and non-athletic controls

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Physiological structural and functional changes to the heart in response to prolonged exercise training include enlargement of the heart chambers and/or mild left ventricular hypertrophy [1]. Available studies bring equivocal results regarding the change in diameter of the coronary arteries (CA) as elements of the athlete's heart [2, 3]. We decided to analyse the changes in diameters of CA and aortic arch vessels in long-term active ultra-marathon runners in comparison to non-athletic controls.

This prospective analysis included 20 healthy male long-term ultra-marathon runners (median age: 40 years, range: 28–54) and 10 male healthy controls who volunteered to participate in the study (median age: 36 years, range: 32–53). The runners had at least 7 years of documented continuous training at a high level (running at least 70 km/week) with frequent starts in ultra-marathons (mostly longer than 100 km). Healthy controls were all sedentary men (recreational sport activity only not exceeding 2 h per week).

To assess the diameters of the arteries departing from the aortic arch and coronary arteries, all patients underwent the post-contrast VIBE and self-navigated free-breathing whole-heart sequence registration using a coronary MR-angiography (whole heart) Siemens Magnetom Skyra 3 Tesla scanner (Siemens, Erlangen, Germany).

It was possible to analyse the diameters of analysed arteries in all of the studied cases and controls. There were no differences in the median diameter of CA and aortic arch vessels between endurance athletes and controls (Table I). There was only a non-significantly larger LM diameter in athletes ($p = 0.08$).

Based on the above results, we suggest that long-term high-intensity endurance training has no significant influence on the enlargement of CA at rest. This is in line with some other studies describing no significant difference in coronary artery diameters in ultra-endurance athletes in comparison to sedentary individuals based on angiography [3]. In contrast to other studies reporting the vascular system adaptation and remodelling in response to physical activity manifesting as enlarged arterial calibre [2], these differences may occur because in most of the studies diameters of coronary arteries were measured during intake of exogenous nitroglycerin or other vasodilators [3]. Also, the diameter may not be enlarged in all circumstances at rest; this may be due to compensatory increases in vasoconstrictor tone to maintain blood pressure.

Interestingly, the aortic arch vessels also showed no significant differences in their diameters. In previous studies, there were reports on increased diameters of peripheral arteries such as femoral arteries in runners or forearm vessels in tennis players. The difference from our results could be explained by the fact that the arteries departing from the aortic arch do not supply oxygen to large skeletal muscle compartments opposite to active limb muscles in runners or tennis players [4].

In conclusion, structural adaptation of CA and aortic arch vessels does not seem to form a part of the physiological adaptation to prolonged endurance training.

Conflict of interest

The authors declare no conflict of interest.

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Table I. Median diameters and diameter range of coronary arteries and arteries departing from the aortic arch in ultra-marathon runners and controls

Parameter	Ultra-marathon runners (*n* = 20)	Controls (*n* = 10)	*P*-value
LM	5.5 (4.4–6.1)	4.95 (4.6–6.0)	0.08
LAD proximal	4.6 (3.3–6.1)	4.8 (4.0–6.2)	0.64
LAD distal	4.2 (3.4–5.3)	3.9 (3.2–4.7)	0.83
Cx proximal	4.6 (3.7–6.4)	4.5 (4.3–5.2)	0.83
Cx distal	4.2 (3.4–5.3)	3.9 (3.2–4.7)	0.83
RCA proximal	5.1 (3.5–6.2)	5.0 (3.2–6.1)	0.75
RCA medial	4.8 (3.3–6.1)	4.85 (4.0–6.0)	0.70
RCA distal	4.0 (2.7–5.1)	4.6 (3.7–5.5)	0.26
BCT	12.4 (10.8–14.4)	12.0 (11.2–14.5)	0.64
RCCA	8.4 (7.8–9.3)	8.4 (6.3–9.5)	0.49
LCCA	9.1 (6.9–11.8)	9.3 (7.9–11.8)	0.98
LSA	12.6 (10.1–15.7)	12.0 (9.6–14.3)	0.47

BCT – brachiocephalic trunk, Cx – left circumferential artery, LAD – left anterior descending artery, LCCA – left common carotid artery, LM – left main stem, LSA – left subclavian artery, RCA – right coronary artery, RCCA – right common carotid artery.

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