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Horse riding as an atypical type of rehabilitation to improve physical capacity in a patient after cardiac surgeries and to enable liver transplantation

Short title: An atypical way of cardiac rehabilitation

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End-stage liver failure, regardless of etiology, is a progressive and fatal disease characterized by the loss of liver function which affects other organs [1]. Cardiopulmonary Exercise Testing attracts great interest as a functional testing used for assessing the risk before liver transplantation (LTx). It may be helpful to predict mortality, morbidity and length of hospitalization after a non-cardiac procedure [2]. Horse riding is a non-standard physical activity in patients before LTx and after cardiac surgeries. It aims to improve motoric functions, body posture and stamina [3].

A 58-year-old male patient with a history of liver cirrhosis and other co-morbidities was admitted for a surgery for the brachycephalic trunk aneurysm. A graft was used to create an anastomosis between the ascending aorta and the right common carotid artery (CCA) and an anastomosis with the distal segment of the brachycephalic trunk was performed. Postoperative

complications occurred: respiratory and renal failure, paroxysmal atrial fibrillation and a worsening of the hepatic function.

Over time, the patient was admitted to the hospital due to a moderately severe condition with symptoms of hepatic encephalopathy, jaundice and ascites. LTx was considered due to end-stage liver disease. Computed tomography angiography showed an aneurysm-like bulge, adjacent to the origin of the left CCA (Figure 1A). It could have been a false aneurysm or the stump of the aneurysm resected earlier. A hybrid procedure based on the implantation of a stent graft into the aortic arch covering the brachycephalic trunk and the left CCA and a right to left carotid-carotid bypass graft (Figure 1B). Qualification for LTx was postponed. 4 months later spirometry revealed pulmonary obturation. Cardiopulmonary Exercise Testing demonstrated exercise oscillation of ventilation and ventilatory obstruction (Figure 1C and 1E), reduced exercise capacity with peak oxygen uptake (VO_{2peak}) 18.9 ml/kg/min and oxygen uptake at anaerobic threshold (AT) 11.2 ml/kg/min (Figure 1G). The walking test was aborted at 5.5 METS due to the patient's fatigue. Additionally complex exertion-induced ventricular arrhythmia was diagnosed. Qualification for LTx was delayed for further 4 months, and pharmacological treatment was included: beta-adrenolytics and bronchodilators. At the next qualification attempt persistent pulmonary obturation and decreased physical capacity were stated and the LTx was postponed for a further 2 months. After that time, without any new pharmacotherapy, the patient demonstrated an improved physical capacity compared with previous exams: better profile of ventilation (Figure 1D and 1F), improved VO_{2peak} 21.9 ml/kg/min and AT 14.2 ml/kg/min (Figure 1H). Walking test with 6.3 METS. No significant heart rhythm disturbances were observed. It came out that the patient had taken up horse riding as rehabilitation as his new hobby which improved his physical performance, and allowed to qualify him for LTx, which was performed without complications.

Physical capacity is an important parameter determining the success of an operation [4]. Unfortunately, there is a lack of data on the beneficial effects of horse-riding rehabilitation on patients suffering from heart and liver diseases. It was analyzed as a therapy for many diseases, but never as a form of rehabilitation after surgery [5]. More research is needed to clearly evaluate the benefits of horse riding on the circulatory system as well as before LTx.

Article information

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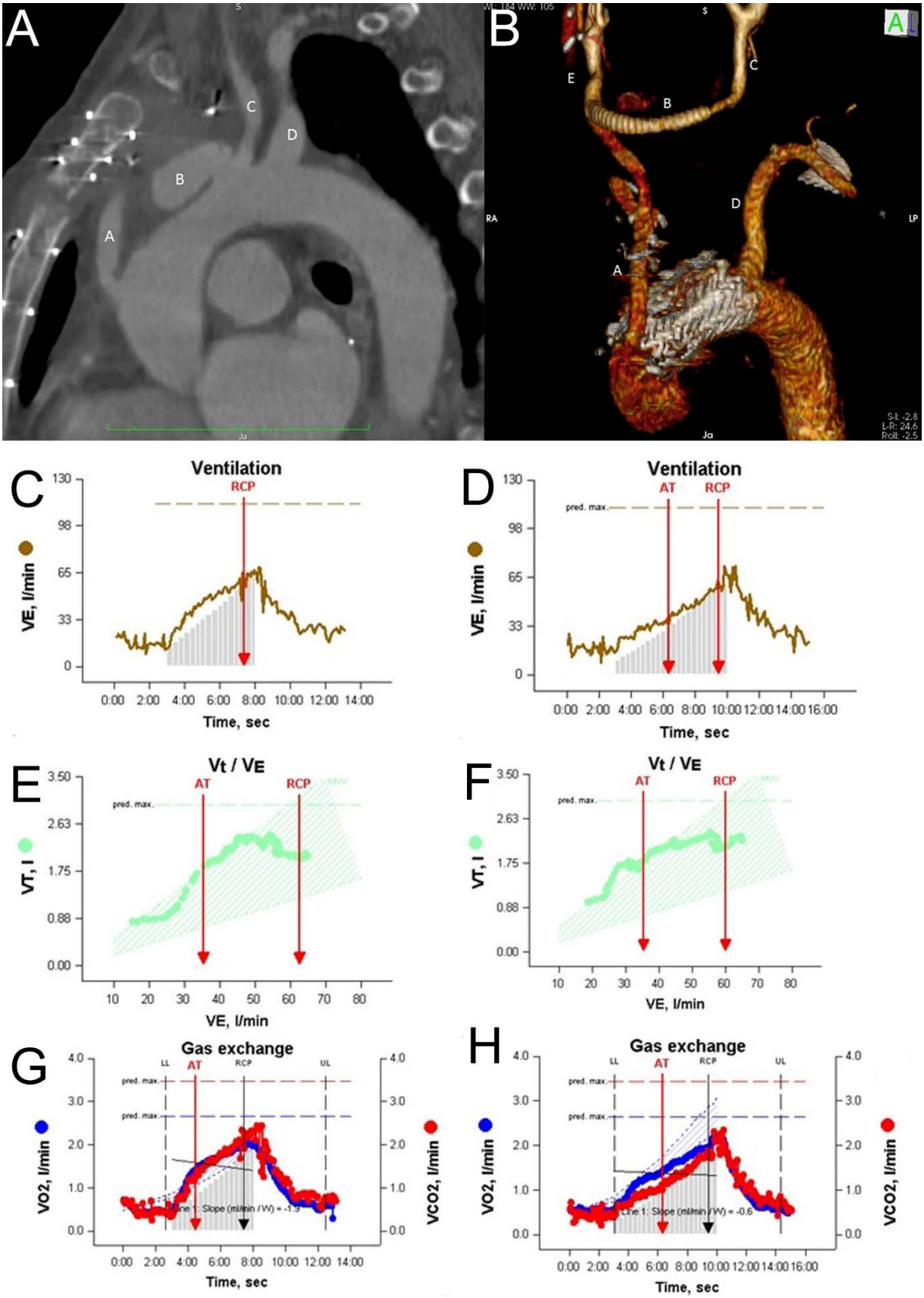

Figure 1. A–B. CT before and after hybrid angiosurgery: **A.** CT scan after cardiac surgery and before hybrid angiosurgery. Pseudoaneurysm of the aortic arch on the level of the origin of LCCA: A — by-pass from the ascending aorta to BCA; B — pseudoaneurysm; C — LCCA; D

— LSA. **B.** Computed tomography angiography 3D reconstruction after hybrid angiosurgery: A — by-pass from the ascending aorta to BCA; B — carotid-carotid by-pass; C — LCCA; D — LSA; E — RCCA; **C–H.** Cardiopulmonary Exercise Testing before (left panels — after angiosurgery, right panels — improvement after rehabilitation before liver transplantation): **C, D.** 1st Wasserman's panel: Changes in profile of ventilation during exercise. **E, F** 7th Wasserman's panel: Changes in relationship between VT and VE during exercise. Left panel presenting severe pattern of obturation; right panel – improvement). **G, H.** 3rd Wasserman's panel: Profiles of VO_2 and VCO_2 during exercise. Right panel — better cardiopulmonary capacity with higher AT

Abbreviations: AT, anaerobic threshold; BCA, brachiocephalic artery; CT, computed tomography; LCCA, left common carotid artery; LSA, left subclavian artery; RCCA, right common carotid artery; VCO_2, carbon dioxide production; VE, minute ventilation; VO_2, oxygen consumption; VT, tidal volume