

Vpliv vadbe hoje na lokomatu na srčni utrip in porabo kisika pri pacientih z nepopolno okvaro hrbtenjače

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Uvod: Za paciente z nepopolno okvaro hrbtenjače je aerobna vadba zaradi pareze velikih mišičnih skupin velik izziv. Za izboljšanje srčno-žilne in dihalne zmogljivosti se odraslim priporoča redna aerobna vadba vsaj zmerne intenzivnosti, ki vključuje velike mišične skupine in ne zahteva veliko spretnosti za izvedbo (1). Vadba hoje na robotski napravi lokomat ustreza tem merilom. Pacientom z okvaro hrbtenjače raziskovalci (2) priporočajo vadbo od tri- do petkrat na teden za 20 do 60 minut pri intenzivnosti od 50 do 80 odstotkov najvišjega srčnega utripa ali največje porabe kisika. Zaradi možnih pridruženih motenj avtonomnega živčevja in nizke telesne zmogljivosti sta pri tej skupini pacientov oba parametra bistveno nižja od predvidenih maksimalnih vrednosti pri zdravih osebah enake starosti (3). Zaradi pareze smo z možnimi fizioterapevtskimi postopki, ki bi zagotavljali tako intenzivnost vadbe, omejeni. Vadba na lokomatu lahko učinkovito vpliva na odzive srčno-žilnega in dihalnega sistema (3). Namen raziskave je bil ugotoviti intenzivnost vadbe pri hoji na lokomatu. Želeli smo opredeliti, kakšen odstotek najvišjega srčnega utripa in največje porabe kisika dosežejo pacienti med hojo v primerjavi z doseženimi vrednostmi pri obremenitvenem testiranju. **Metode:** V raziskavo smo vključili priložnostni vzorec osmih preiskovancev z nepopolno okvaro hrbtenjače (3 ženske, 5 moških), starih povprečno 53,5 leta (SO 13 let), povprečno 11 tednov po začetku okvare (SO 5 tednov). Pri štirih je bila vzrok okvare poškodba, pri drugih bolezen. Pri dveh je bila posledica okvare parapareza, pri drugih tetrapareza. Najvišji srčni utrip in največjo porabo kisika smo določili z obremenitvenim testiranjem na ročnem kolesu z neposrednim merjenjem porabe kisika in telemetričnim zapisom elektrokardiograma (Oxicon Mobile - Viasys). Meritve na sistemu lokomat (Hocoma) smo opravili po 10 minutah hoje, pri hitrosti 1,5 km/h, s povprečnim 48-odstotnim (SO 8,2 %) odvzemom telesne teže. Preiskovance smo z razlago pomena in delovanja povratne informacije o aktivni udeležbi spodbudili k čim dejavnejši hoji. Za merjenje srčnega utripa in porabe kisika smo uporabili enak sistem kot pri obremenitvenem testiranju. Raziskavo je odobrila Komisija za medicinsko etiko Univerzitetnega rehabilitacijskega inštituta - Soča. **Rezultati:** Preiskovanci so v povprečju dosegli 69,1 % (SO 13,5 %, razpon 52–89 %) najvišjega srčnega utripa, doseženega na obremenitvenem testiranju. Sedem preiskovancev je v povprečju doseglo 78,4 % (SO 14,6 %, razpon 59,2–96,8 %) največje porabe kisika. En preiskovanec je med vadbo na lokomatu dosegel 1,4 % večjo porabo kisika kot pri obremenitvenem testiranju. Povprečna vrednost porabe kisika na lokomatu je bila 10,1 mL/kg/min (SO 2 mL/kg/min, razpon 7,3–12,6 mL/kg/min). **Zaključki:** V povprečju so preiskovanci dosegli vrednosti srčnega utripa in porabe kisika, ki bi ob primernem trajanju in pogostosti vadbe lahko vplivale na izboljšanje srčno-žilne in dihalne zmogljivosti. Povprečna vrednost porabe kisika naših preiskovancev med hojo na lokomatu je bila primerljiva z vrednostmi drugih raziskovalcev (4, 5). Tako srčni utrip kot poraba kisika se ob spodbujanju preiskovancev k dejavnejši hoji povečata (5), k čemur je verjetno pripomogla povratna informacija o aktivni udeležbi med hojo. Omejitve naše raziskave so bile majhen in priložnostni vzorec ter heterogenost preiskovancev.

Ključne besede: poškodbe hrbtenjače, robotika, intenziteta vadbe, rehabilitacija.

Influence of gait training using lokomat on heart rate and oxygen uptake in patients with incomplete spinal cord injury

Background: Aerobic exercise presents great challenge to patients with incomplete spinal cord injury due to paresis of large muscle groups. For improving cardiovascular and respiratory capacity recommendations for adults include regular aerobic exercise of at least moderate intensity, which includes large muscle groups and does not require great skills for execution (1). Gait training using lokomat meets these criteria. For patients with spinal cord injury, exercising three to five times a week for 20 to 60 minutes with intensity of 50 to 80 % of peak heart rate or peak oxygen uptake is recommended (2). Due to possible disorders of autonomic nervous system and low physical capacity both are significantly lower in this group of patients than in healthy persons regarding the age (3). Physiotherapeutic procedures of appropriate intensity are difficult to apply due to paresis. Gait training using lokomat may effectively influence cardiovascular and respiratory system (3). The purpose of the study was to determine intensity of gait training using lokomat. We wanted to define the percentage of peak heart rate and peak oxygen uptake during walking compared to values attained with exercise stress testing. **Methods:** We included convenience sample of eight subjects with incomplete spinal cord injury (3 females, 5 males), aged 53.5 years (SD 13 years), on average 11 weeks after injury onset (SD 5 weeks). Impairment was caused by injury in four subjects, in others the cause was a disease. In two the result of impairment was paraparesis, in others tetraparesis. Peak heart rate and peak oxygen uptake were determined with exercise stress testing using arm ergometer with direct measurement of oxygen uptake and telemetric electrocardiogram record (Oxycon Mobile – Viasys). Measurements on the lokomat (Hocoma) were conducted after 10 minutes of walking, with speed set at 1.5 km/h and average body weight support of 48 % (SD 8.2 %). With the explanation and usage of feedback information about active participation subjects were encouraged to actively participate in gait. For heart rate and oxygen uptake measurements the same system was used as with the exercise stress testing. Study had been approved by the Ethics committee of University rehabilitation institute. **Results:** Subjects achieved on average 69.1 % (SD 13.5 %, range 52–89 %) of peak heart rate. Seven subjects achieved on average 78.4 % (SD 14.6 %, range 59.2–96.8 %) of peak oxygen uptake. One subject achieved 1.4 % higher value of oxygen uptake than with exercise stress testing. Average oxygen uptake on the lokomat was 10.1 mL/kg/min (SD 2 mL/kg/min, range 7.3–12.6 mL/kg/min). **Conclusions:** On average subjects achieved values of heart rate and oxygen uptake that might, in case of adequate duration and frequency, improve cardiovascular and respiratory system capacity. Average oxygen uptake during gait training using lokomat was comparable with values in other studies (4, 5). Heart rate and oxygen uptake increase with encouragement towards active gait (5), to which feedback information about active participation during gait training probably contributed. Limitations of the study were small sized and convenience sample and heterogeneity of subjects.

Key words: spinal cord injuries, robotics, training intensity, rehabilitation.

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