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Case Reports

EXCEPTIONAL EXERCISE CAPACITY IN AN 80-YEAR-OLD BREAST CANCER SURVIVOR AND LONG-TERM SPRINT ATHLETE

To the Editor: Several measures of health and function determine future outcomes in older adults. Maximal oxygen (O_2) uptake (VO_2max), reflecting the upper limits of aerobic function, characterizes the integration of the central nervous, cardiopulmonary, and metabolic systems.[1] Although health and function decline gradually with age, little is known regarding VO_2max, cardiorespiratory reserve, body composition, and psychological profile in relationship to lifelong physical activity patterns. Nevertheless, older adults can significantly improve physical function with a healthy lifestyle.[2] The characteristics of a well-educated 80-year-old female world master sprint athlete with a history of breast cancer and lifelong physically active lifestyle are reported.

The subject competed to the age of 28. After participation in competitive athletics, she had no formal training but maintained an active lifestyle up to the age of 52, when she restarted regular training for short competitive track events. She trained 3–6 hours per week, 4 days per week, for 28 years, and occasionally participated in endurance events. The objective of her training program was the development of speed, aerobic power, and flexibility by means of continuous and interval running (maximum 1,000 m) and systematic stretching.

In 2011, she was diagnosed with infiltrating ductal carcinoma of the right breast and was treated with mastectomy, axillary node dissection, and antiestrogen treatment. Soon after the diagnosis, she expressed the desire to stay active during and after treatment, and her training schedule was individualized based on her ability to stay active and in accordance with her oncologist's recommendations.

In 2013, she was European Master Athlete of the year, and in 2014 she was World Champion in the 60, 200, and 400 m.

She performed a maximal cardiopulmonary incremental field-running test using a portable metabolic cart. Characteristics of the subject are presented in Table 1. The most salient observation was the high VO_2max (42.7 mL/kg per minute), more than twice the predicted value for sedentary 80-year-old men and women and higher than that for octogenarian lifelong male cross-country skiers (38 ± 1 mL/kg per minute).[3,4]

Exercise capacity is a strong and independent predictor of outcomes, supporting the value of exercise testing as a clinical tool. VO_2max is an important marker of risk in individuals with different clinical conditions and in some studies has been a shown to be a better predictor of mortality than established cardiovascular risk factors in subjects with and without cardiovascular disease.[5]

A VO_2max of 17.5 mL/kg per minute is considered to be the threshold for frailty.[1] The 25.2 mL/kg per minute difference between the threshold for functional independence and that observed in this subject is one of the largest cardiorespiratory reserves described for older adults. VO_2max is primarily attributable to a high cardiac output (heart rate x stroke volume).[1] Reduction in maximal heart rate is one of the principal causes of decline in aerobic capacity with age.[6] The remarkably high maximal heart rate in this woman (171 beats/min), undoubtedly contributed to her high VO_2max. In addition, the high O_2 pulse (an indicator of stroke volume) at peak effort is comparable with that reported for master athletes and higher than that observed in age-matched nonexercisers.[7] O_2 pulse typically declines from approximately 25 mL/min in

Table 1. Subject Characteristics

Characteristic	Value
General	
Age	80
Mini-Mental State Examination score	29/30
Center for Epidemiologic Studies Depression Scale score	9/60
Pearlin and Schooler Mastery Scale score	23/30
Anthropometric	
Height, cm	158
Weight, kg	57
Body mass index, kg/m^2	22.8
Fat mass, %	28.5
Lean body mass, %	71.5
Skeletal muscle index, muscle mass/height^2	16.6
Appendicular lean mass, kg/height^2	7.3
Metabolic	
Hemoglobin, g/dL	14.4
Glucose, mg/dL	95
Insulin, μIU/mL	11.5
Homeostatic model assessment of insulin resistance	2.7
Total cholesterol, mg/dL	242
Triglycerides, mg/dL	81
High-density lipoprotein cholesterol, mg/dL	55
Low-density lipoprotein cholesterol, mg/dL	171
Cardiopulmonary	
Test duration, minutes:seconds	12:20
Maximal oxygen uptake L/min	2433
L/kg/min	42.7
Maximum heart rate, beats per minute	171
O_2 pulse, mL O_2/beat	14.2
Maximum ventilation, L/min	99
2014 personal best performance	
60 m, seconds	11.55[a]
200 m, seconds	39.12[b]
400 m, minutes:seconds	1:31.10[c]

[a]Ancona, Italy, March 8, 2014, indoors.
[b]Izmir, Turkey, August 30, 2014, outdoors.
[c]Budapest, Hungary, March 27, 2014, indoors.
O_2 = oxygen.

young endurance athletes to approximately 18 mL/min in 70-year-old master athletes.[8] Considering the older age of this woman, the O_2 pulse of 14.2 mL/min per beat suggests high cardiac function, probably because of her lifelong training. Maximal ventilation (99 L/min) similar to the upper limits recently described in octogenarian athletes[3] was also observed. Ventilatory efficiency, reflected by the rise in minute ventilation relative to oxygen uptake, was 27, which reflects good integrated function of the cardiorespiratory and skeletal muscle systems.[9]

An excellent body composition despite her advanced age and aromatase-inhibitor treatment was also observed using dual-energy X-ray absorptiometry. Sarcopenia (low lean mass and high fat mass relative to body size) is associated with mobility limitation, comorbidities, and mortality in elderly individuals. She had greater lean mass (16.6 vs 15.1 kg/m^2) and lower fat mass (28.5% vs 39.1%) than well-functioning white women aged 70–79,[10] further supporting the hypothesis that lifetime physical activity might attenuate the negative effects of aging. Normal fasting glucose, insulin levels, and lipoprotein profile were in line with the results of the anthropometric evaluation.

This case study describes a robust, resilient, successful aging phenotype. The observed aerobic power and corresponding functional reserve were approximately twice those of healthy untrained men. This case suggests that participation in lifelong exercise may help to maintain the plasticity of numerous physiological systems at 80 years old, which has direct benefits for overall health and reduces the risk of impairment and disability.

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MEMANTINE-INDUCED MYOCLONUS PRECIPITATED BY RENAL IMPAIRMENT AND DRUG INTERACTIONS

To the Editor: Memantine is an uncompetitive N-methyl-D-aspartate (NMDA) receptor antagonist that the Federal Drug Administration has approved for use in moderate to severe Alzheimer's disease (AD). Memantine is generally well tolerated, with few adverse effects. Herein an unusual case of memantine-induced myoclonus in an older person with Lewy body dementia (LBD) is reported.

A 93-year-old Chinese man was admitted with a 1-day history of confusion and worsening of bilateral myoclonus of all four limbs that had started 2 months before. He had previously been started on memantine 10 mg twice a day 4 months earlier for a presumptive diagnosis of AD. Other significant medical history included prostate carcinoma, diabetes mellitus, and hyperlipidemia. Three days before admission, he was prescribed dextromethorphan, levofloxacin, and chlorpheniramine for an upper respiratory tract infection.

Physical examination was significant for the presence of myoclonic jerks in all four limbs and subtle Parkinsonism. He was conscious and able to follow commands with no localizing neurological deficit. Further history from the family corroborated by inpatient observations revealed prominent visual hallucinations, fluctuating attention, and rapid eye movement sleep behavioral disorder, prompting a revision of the etiological diagnosis to LBD. Investigations revealed *Escherichia coli* urinary tract infection associated with acute renal impairment (creatinine 193 μmol/L, creatine clearance (CrCl) 19 mL/min; baseline creatinine 133 μmol/L, baseline CrCl 27 mL/min). Laboratory investigations were otherwise unremarkable. Magnetic resonance imaging of the brain revealed a small chronic lacunar infarct in the left caudate head that was deemed to be an incidental finding. Electroencephalography showed no epileptiform activity.

Memantine was stopped on the day of admission, and low-dose clonazepam was started for symptomatic

Table 1. Summary of Case Reports

Article	Age	Type of Dementia	Memantine Dose	Duration of Exposure to Memantine	Concurrent Medications	Other Contributing Factors	Relevant Findings
Marwan et al.[7]	83	Lewy body dementia	Not stated	Not stated	Donepezil (dose not stated)	None of note	Increased agitation, myoclonus, hallucinations, falling
Papageorgiou et al.[8]	79	AD	15 mg/d	3 weeks	Donepezil 10 mg/d	None of note	Exacerbation of myoclonus (from occasional to persistent myoclonic jerks) with memantine Myoclonus ceased completely within 1 week of cessation of memantine
Dan et al.[9]	78	AD	5 mg every morning, 10 mg every night	Not stated	Donepezil 10 mg/d Paroxetine 20 mg/d Lisinopril 10 mg with hydrochlorothiazide 12.5 mg 0.5 tablets every morning Atorvastatin 10 mg/d Trimethoprim 100 mg/d	Proteus urinary tract infection Impaired renal function	Myoclonus of bilateral upper and lower extremity, agitation and confusion Myoclonus started within days of starting trimethoprim Myoclonus resolved within 48 hours after cessation of memantine and other medications
Naoyuki et al.[10]	76	Mixed AD and vascular dementia	5 mg/d	6 days	Not stated	Chronic kidney disease	Myoclonus of head and upper extremity
Lim et al. 2015	93	Lewy body dementia	10 mg twice a day	2 months	Levofloxacin 500 mg every morning Chlorpheniramine 2 mg three times per day Valsartan 80 mg every morning Bicalutamide 50 mg every morning	Worsening renal impairment	Myoclonus of bilateral upper and lower extremities

AD = Alzheimer's disease.