

## CASE REPORT

## How to exhaust your bone marrow

Louise Salomo,<sup>1</sup> Morten Salomo,<sup>2</sup> Steven A W Andersen,<sup>2</sup> Anne-Lise Kamper<sup>1</sup>

<sup>1</sup>Department of Nephrology, University of Copenhagen, Rigshospitalet, Copenhagen, Denmark

<sup>2</sup>Department of Haematology, University of Copenhagen, Rigshospitalet, Copenhagen, Denmark

**Correspondence to**

Louise Salomo,  
Louise@salomo.dk

**SUMMARY**

A 32-year-old man was admitted to the hospital because of oedema and 8 kg of gained weight. The oedema decreased spontaneously over weeks and there was no evidence for a nephrotic syndrome; however, the blood tests revealed a moderate pancytopenia. The patient practiced excessive physical activity at work and in his spare time, and kept a very thorough training and weight diary. Owing to a high intake of energy and protein drinks he tried to optimise his physical performance and kept a normal body mass index at 23.7. A bone marrow biopsy showed gelatinous bone marrow transformation, normally seen in critically ill patients or those with severe malnutrition. In this case, the cause is presumed to be excessive physical activity/overtraining in combination with relatively insufficient nutrition.

**BACKGROUND**

Gelatinous marrow transformation or serous atrophy of bone marrow is seen in severe nutritional deprivation like anorexia nervosa, severe malnutrition or cachexia, in general. It most often causes anaemia, and is described as an indicator of severe disease. Here we present an apparently very healthy young man with unhealthy habits and a resulting gelatinous bone marrow transformation.

This case report illustrates a previously undescribed side effect of excessive physical exercise and highlights a health problem related to modern extreme life habits.

**CASE PRESENTATION**

A 32-year-old man was admitted to the department of nephrology in June 2012 because of oedema and 8 kg weight gain within 1 week. The patient had a history of inguinal hernia repair in 2011 and an episode of macroscopic haematuria 10 months earlier. At that time cystoscopy, CT urography and P-creatinine were normal. The B-haemoglobin was 12.4 g/dL, B-leucocytes  $3.2 \times 10^9/L$  and B-thrombocytes  $122 \times 10^9/L$ , but this did not lead to further examination.

On admission the oedema of the face and lower extremities had spontaneously decreased and the patient showed only mild pitting oedema to mid crura. His general condition was good. His body weight was 83 kg, body mass index (BMI) 23.7, blood pressure 142/90 mm Hg with a sinus bradycardia 38 bpm.

The patient was a professional soldier and had long practiced intensive exercise in his spare time. His daily training included about 20 km of running and strength training. Approximately 3 months earlier he had completed a 'brutal' marathon in less

than 3 h. He kept a very thorough training and weight diary and had a high intake of energy and protein drinks in order to optimise his physical performance. These supplements were over the counter preparations and its ingredients are not known to be potentially bone marrow toxic. Once a week he had a tendency to binge eating with chips, candy and chocolates.

Renal disease was excluded by normal creatinine clearance of 135 mL/min, 24 h urinary albumin excretion of 0.2 g, urinary dip-stix negative for blood and Doppler ultrasonography demonstrating normal morphology and perfusion of the kidneys and no dilation of the urinary outflow tract. P-urea was slightly increased 30.8 mg/dL probably owing to high protein intake. P-albumin was 4.3 g/dL and urinary culture was negative. Antiglomerular basement membrane antibodies, antineutrophil cytoplasmic antibodies titres and antinuclear factor were negative.

Mild pancytopenia was demonstrated with B-haemoglobin 11.2 g/dL,  $\beta$ -leucocytes  $2.4 \times 10^9/L$  and B-thrombocytes  $109 \times 10^9/L$ . P-LDH, P-alkaline phosphatase, P-folic acid, P-iron, P-ferritin, mean corpuscular haemoglobin concentration, P-cobalamin, P-uric acid and P-immunoglobulins were normal. Thyroid screening was normal (thyroid stimulating hormone, free T4 and free T3). Epstein-Barr virus PCR was negative. HIV test was negative. Chest X-ray and abdominal sonography were normal apart from a small haemangioma in the right liver lobe. A bone marrow biopsy was performed and the diagnosis was hypocellular bone marrow with gelatinous transformation. There were normal findings in flow cytometry and chromosome analysis. The overall picture was interpreted as gelatinous transformation of the bone marrow with moderate pancytopenia on the basis of relative anorexia although the patient had a normal BMI and the nutritional status was normal.

**TREATMENT**

The patient was advised to reduce his exercise in order to allow proper regeneration of bone marrow function.

**OUTCOME AND FOLLOW-UP**

In January 2013, the patient had followed the advice and gained weight and blood test revealed a regeneration of the bone marrow except from moderate anaemia.

**DISCUSSION**

Gelatinous transformation of the bone marrow is a rare phenomenon seen in patients with marked malnutrition, various malignancies, severe

**To cite:** Salomo L, Salomo M, Andersen SAW, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2013-009210

infections and HIV/AIDS.<sup>1</sup> In the present case, the patient had no sign of malnutrition. He had a very high level of physical activity and had great attention to an optimal diet.

Excessive physical stress is known to cause varying degrees of organ damage.<sup>2</sup> The resulting overtraining syndrome (OTS)<sup>3</sup> is a well-described phenomenon with neurological, endocrinological, immunological and psychological symptoms. There are several theories regarding the pathogenesis of OTS. One hypothesis involves inflammatory processes with a dysregulated cytokine response, which also could mediate bone marrow suppression, as observed in this patient. A similar case with gelatinous transformation in a patient with OTS has been described earlier; however, his BMI decreased to 18.6.<sup>4</sup>

The oedema, which led to hospitalisation of the patient, was probably a part of OTS.

This is to our knowledge is the first report describing gelatinous transformation in an otherwise healthy person. The cause is presumed to be excessive physical activity in combination with insufficient nutrition despite normal BMI and normal P-albumin.

**Contributors** All authors have contributed equally to identification of the case and preparation of manuscript.

**Competing interests** None.

**Patient consent** Obtained.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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### Learning points

- ▶ Excessive training can damage to your health even if normal body mass index is sustained.
- ▶ Cytopenia may be a new symptom of overtraining.
- ▶ Gelatinous transformation of the bone marrow is the histopathological correlate of the observed cytopenia.
- ▶ Adequate reduction of training can overcome the problem.

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