Hypokalemic thyrotoxic paralysis: a rare cause of tetraparesis with acute onset in Europeans

Abstract We describe a 21-year-old Italian male affected by hypokalemic tetraparesis with acute onset. In the emergency ward, the patient was agitated, with tachycardia (140/min) and systolic hypertension (180/70 mm Hg). He was not able to flex the lower extremities against a light resistance and furthermore, he was hypotonic and without tendon reflexes. One hour later he developed strength deficit of the upper extremities as well. Biochemical analyses revealed severe hypopotassemia (2.1 meq/l). After administration of 140 meq potassium phosphate, the patient began to improve, and 12 h after the onset he was able to walk normally. Successive investigations documented an undiagnosed case of Graves’ disease. Thyrotoxic hypokalemic paralysis has been observed almost only in Asians, however, with this case and others reported, we believe that it should be considered as a cause of muscular paralysis also in Caucasians.

Key words Hypokalemic • Tetraparesis • Hyperthyroidism • Caucasians

Introduction

Hypokalemic paralyses constitute a heterogeneous group of diseases whose common denominator is profound asthenia or muscular paralysis associated with varying degrees of hypopotassemia. The most frequent form is familiar periodic paralysis. Sporadic cases have been described in association with hyperaldosteronism, renal tubular acidosis, elevated liquorice consumption, and barium intoxication.

Thyrotoxic periodic paralysis (TPP) is a well-known phenomenon among Asians (more than 90% of the cases reported in the literature) [1-3]. Although hypokalemic thyrotoxic periodic paralysis (HTPP) is rare in Caucasian patients, sporadic reports of cases in Europe have been published in the last decade and the most recent one was from Switzerland [4]. Furthermore, isolated cases have been reported among Blacks and American Indians [5]. The gene defect is unknown in this disorder while mutations of the dihydropyridine receptor have been found in autosomal dominant and sporadic hypokalemic periodic paralysis [6].

We present the case of a 21-year-old Italian male who was admitted to the emergency ward of a suburban hospital with a dramatic picture of hypokalemic tetraparesis with acute onset consequent to undetected hyperthyroidism. The physiopathology and treatment of the dyselectrolytic neuromuscular manifestations of this rare mode of presentation of Graves’ disease will be briefly discussed.

Case report

A 21-year-old Italian male storekeeper experienced a fall as the result of a sudden loss of strength in the legs as he was getting up from an armchair. He had been in a sitting position for approximately one hour after an evening meal based on carbohydrates. His physical activity during the day had been of a medium-high level, i.e. normal for his job as storekeeper. In
the preceding six months he had lost about 10 kg in weight, without the appetite being affected.

On first observation in the emergency ward, the patient presented agitation, tachycardia (140/min) and systolic hypertension (180/70 mm Hg). He was incapable of flexing the lower limbs against a light resistance. The deficit of strength was symmetrical and prevalent in proximal muscles. The patient was hypotonic, with abolished tendon reflexes. The cutaneous plantar response was flexed, and sensitivity was normal. A slight diffuse enlargement of the thyroid was present. There was no evidence of exophthalmos, fixity of gaze, or palpebral retraction. One hour later the strength deficit extended to the upper limbs, mainly involving proximal muscles. The left upper limb appeared more affected than the controlateral.

Laboratory analyses

An electrocardiogram (ECG) showed sinus tachycardia and ST depression. Biochemical analyses of the blood indicated severe hypokalemia (Table 1). Blood urea nitrogen, glucose, Na⁺, Mg²⁺ and Ca²⁺ were normal.

The patient was treated with an intravenous administration of 20 meq/l potassium phosphate to a total of 140 meq. The administration was interrupted at blood K⁺ levels of 4.2 meq/l. After 6 h from the onset of treatment the patient began to show an improvement of muscular strength and the appearance of tendon reflexes. After approximately 12 h from onset of symptoms, the patient was able to walk normally.

Subsequent analyses (Table 2) showed low thyroid-stimulating hormone (TSH) and severely elevated free triiodothyronine and thyroxine (FT3 and FT4), indicative of undiagnosed hyperthyroidism. The concentrations of blood renin and aldosterone in both the inclined and upright positions were within the norms (data not shown).

Histologic findings

Muscle biopsy was performed 72 h after the initial onset of symptoms. The presence of vacuoles derived from ectasia of the sarcoplasmic reticulum was seen at light microscopy.

Discussion

TPP is a possible complication of an untreated hyperthyroid state, more frequently observed in Asians, with an incidence that varies according to different estimates from 1.8% [2] to 8.8% [3]. In North America, excluding the population of Asian origin, the incidence is 0.1%-0.2% [7].

We did not find data concerning the incidence of TPP within the European population, however, in the last decade there has been an increasing number of Caucasian cases reported [4, 8, 9]. The case reported here is, from a clinical point of view, similar to that described in the principal reviews of the literature [2, 7, 10] and indistinguishable from that of familiar hypokalemic periodic paralysis. Of particular note are: (a) the acute onset and rapid development of the paralysis; (b) the prevalent involvement of the proximal musculature with onset generally in the lower limbs; and (c) the absence of involvement of the bulbar musculature.

Some authors have observed that the paralysis arises not during physical exertion but under conditions of rest, and that often it follows a meal based on carbohydrates [10]. Both these circumstances were also present in our case. Finally, in all cases reported in the literature, the symptoms disappeared after correction of the hyperthyroidism.

The precise nature of the disorder responsible for TPP is unknown. However, it has been demonstrated that thyroid hormone is able to induce a marked increase of activity of the ATPase-dependent Na⁺-K⁺ pump in skeletal muscle, liver and kidneys [11]. This effect is probably mediated by beta-adrenergic stimulation [12]. The result would be hypokalemia due to an intracellular shift of potassium, the body’s total pool of the ion remaining intact. However, in the rare Caucasian patients with HTPR, the abnormalities responsible for the muscle weakness [9] are rather of the sodium and/or calcium channels, instead of the hyperactivity of the Na⁺-K⁺ pump.

Histologically, the salient aspect of TPP is the formation of numerous vacuoles within the muscular fiber deriving from ectasia of the sarcoplasmic reticulum [13]. Such a histological pattern was also found in our case.

Thyrotoxic hypokalemic paralysis is a condition that has been observed almost exclusively within the Asian population. We have presented the case of a young Italian male affected by tetraparesis, with acute onset, discovered to be consequent