of Nijmegen, Netherlands). Using this spectrophotometer, which generates light at 905, 850, and 770 nm, it is possible to differentiate between oxyhaemoglobin/myoglobin (O_2Hb/O_2Mb) and deoxyhaemoglobin/myoglobin (HHb/HMb). The optical fibres were placed on top of the flexor digitorum superficialis muscle in the same location for all the measurements. Data were sampled at 10 Hz.

Quantitative NIRS values for oxygen consumption ($m\dot{V}O_2$) were calculated by evaluating the rate of decrease in $[O_2Hb]$ during arterial occlusion, as previously described.⁴ Reoxygenation rate (ΔO_2Hb) was determined as the rate of initial increase in O_2Hb measured over three seconds immediately after cessation of arterial occlusion. Both $m\dot{V}O_2$ and ΔO_2Hb were calculated at rest and following rhythmic isometric handgrip exercise at various work intensities. Each exercise session consisted of one minute of exercise at a contraction rate of 30/min (50% duty cycle), immediately followed by 45 seconds of arterial occlusion for the calculation of $m\dot{V}O_2$ and ΔO_2Hb . Whereas $m\dot{V}O_2$ is a measure of mitochondrial function at a certain work intensity and is dependent on the vascular capacity of oxygen delivery, ΔO_2Hb reflects the initial recovery rate at which deoxygenated haemoglobin/myoglobin are resaturated.⁵ It is therefore directly related to microvascular function. All measurements were performed at the same absolute work intensities.

Figure 1 shows the effect of corticosteroid treatment, measured non-invasively and with relative ease by NIRS, in the patient with severe dermatomyositis. Before treatment was begun, resting $m\dot{V}O_2$ was slightly higher than in healthy controls ($0.19 \text{ v } 0.14 \text{ ml } O_2/\text{min}/100 \text{ g}$, respectively). However, $m\dot{V}O_2$ during exercise was about 60% lower than in the controls over the whole range of exercise intensities (fig 1A). After three weeks of treatment, $m\dot{V}O_2$ had already markedly increased. After seven weeks, $m\dot{V}O_2$ had increased even further and was now only 25% below that of the controls, and within the normal range at several work intensities. Serum CK levels were normalised, while muscle strength had increased. ΔO_2Hb (fig 1B) showed similar results, with slow recovery rates before treatment was begun and an increase over all work intensities at the three week and seven week examinations. ΔO_2Hb after seven weeks of treatment exceeded the normal mean value.

As NIRS measures local oxygenation and haemodynamics within the muscle, it can give direct insight into the working microvascular system. ΔO_2Hb increased during treatment, indicating an increase in capillary function. As a result of the increased capillary function and a possible regeneration of muscle fibres, muscular oxygen availability increased, enhancing oxidative capacity—as reflected by the increase in local muscle oxygen consumption.

Although a muscle biopsy will remain indispensable for the diagnosis of dermatomyositis, NIRS is an interesting and non-invasive tool for monitoring the effect of treatment non-invasively and with relative ease. While both serum CK levels and muscle strength are indirect measures, and muscle biopsies provide only a static fingerprint of the

Figure 1 Effect of treatment in a patient with severe dermatomyositis. (A) Muscle oxygen consumption ($m\dot{V}O_2$), and (B) reoxygenation rate (ΔO_2Hb) measured non-invasively by near-infrared spectroscopy at rest and after exercise at different levels of maximum voluntary contraction force (MVC). Mean values $\pm$ SD are shown for the controls.

muscle, NIRS measures local microvascular and mitochondrial function directly in the intact and working physiological setting.

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Propofol in myoclonus status epilepticus in comatose patients following cardiac resuscitation

Myoclonus status epilepticus has been identified as a poor prognosticating sign in comatose patients following cardiopulmonary resuscitation.¹ These vigorous generalised jerks are considered to be the penultimate phenomenon in a severely damaged brain that is difficult to manage and that may cause difficulty in ventilating the patient. Antiepileptic drugs such as phenytoin or benzodiazepines have not been very successful. When the jerks are particularly severe, neuromuscular junction blockers have been recommended.¹ I

report on two comatose patients with myoclonus status epilepticus. Propofol in a subanaesthetic dose muted these movements considerably.

A 77 year old patient with a prior history of rheumatoid arthritis was resuscitated at home after sudden collapse. The emergency medical service found no pulse. He was defibrillated, and after resuscitation of approximately 70 minutes, pulse and blood pressure returned. In the coronary care unit, he had generalised myoclonus in the face, limbs, and abdomen muscles and the movements were particularly sensitive to touch. His Glasgow coma score was 3 and brainstem reflexes were intact. These rhythmic jerks interfered with mechanical ventilation and caused repetitive bucking of the ventilator. He was treated with fosphenytoin (phenytoin equivalents 20 mg/kg), which subsequently reduced his blood pressure to 80 mm Hg but which quickly returned to a normal level. He was placed on a propofol infusion titrated to a maximal dose of 65 $\mu\text{g}/\text{kg}/\text{min}$, and myoclonus disappeared. After treatment for three hours, propofol was discontinued. An electroencephalogram showed a burst suppression pattern. Myoclonic jerks returned and, in addition, constant blinking was noted. The patient did not awaken after discontinuation of propofol on the second day.

A 19 year old boy was found hypothermic (core temperature of 31°C) in the field after a car rollover. He was resuscitated for 30 minutes before heart rate returned. On admission, his Glasgow coma score was 3. Notable signs were constant facial jerking, biting on the endotracheal tube, and sound sensitive myoclonus jerks in all limbs. Propofol in a dose of 35 $\mu\text{g}/\text{kg}/\text{min}$ significantly muted myoclonus, although occasional myoclonic jerk was noted in both legs. An electroencephalogram showed a burst suppression pattern. Computed tomography showed poor white-grey matter differentiation, indicating early brain oedema. Care was withdrawn after the patient did not recover from coma after discontinuation of propofol.

Control of generalised myoclonus status epilepticus has been difficult and frustrating. I noted that the use of propofol in a fairly low dose muted myoclonus considerably. The typical dose in the intensive care unit is 5 $\mu\text{g}/\text{kg}/\text{min}$, which can then be titrated to 50–

100 µg/kg/min. Propofol has been suggested as a possible treatment for refractory status epilepticus, although hard data of its therapeutic effect are not yet available.² Propofol has not been used in this condition before but has been effective in two earlier case reports of severe myoclonus: one patient had chloralose poisoning and one had "encephalopathy."³⁻⁵ In this condition a catastrophic anoxic-ischaemic injury may have damaged the cortex, basal ganglia, brain stem, and spinal cord and thus the origin of myoclonus remains undetermined. Propofol may terminate myoclonus through enhancement of γ amino butyric acid type A receptor. Further experience is needed, but these case reports indicate that good control can be achieved. Propofol's additional benefit is that intermittent neurological assessment remains reliable after discontinuation of propofol.

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Chronic asymmetric progressive external ophthalmoplegia with right facial weakness: a unique presentation of mitochondrial myopathy

Because of genetic heteroplasmy, the clinical manifestations of mitochondrialopathies are quite varied. We report an unusual presentation in a patient with asymmetric ophthalmoplegia and unilateral myopathic facial weakness caused by a deletion in mitochondrial DNA.

Case history

The patient, a 42 year old white woman, was evaluated in our neurology clinic for double vision and right sided facial weakness in early 2000. She first noticed these symptoms in 1994. At that time, she had isolated weakness of adduction of the right eye and she was felt to have a right internuclear ophthalmoplegia. A demyelinating process was considered initially, but magnetic resonance imaging of the brain on four subsequent occasions (annual scans) did not show any structural lesions to support such a diagnosis. The diplopia remained unchanged and an insidious facial weakness developed.

During the course of her illness she had extensive investigations, including normal cerebrospinal fluid, antinuclear antibodies, erythrocyte sedimentation rate, serum protein electrophoresis, and thyroid profile. Rapid plasma reagin and Lyme's titre were negative. She received several courses of high dose steroids without any improvement.

There had been no substantial change in her general physical condition since 1994. Her past medical history was otherwise unremarkable. She is a computer operator and is quite active in sports. She has smoked moderately for 30 years. She has no family history of any neurological disorders. There was no diurnal variation of her symptoms and no complaint of dysphagia, dysarthria, or limb weakness.

Neurological examination revealed a pupillary sparing ophthalmoplegia without ptosis. Specifically she had bilateral exotropia on primary gaze, with total paralysis of adduction of the right eye and mild weakness of abduction of the left eye. She also had mild paresis of infraduction of the right eye. Nystagmus was absent in both horizontal and vertical gaze. She had an infranuclear right facial weakness involving both the orbicularis oculi and the orbicularis oris, without lid synkinesis. The strength in the left facial muscles was normal. Ophthalmoscopic examination was normal. The remainder of her neurological examination was unremarkable. In summary, this patient had a chronic asymmetrical pupil and lid sparing ophthalmoplegia with binocular diplopia and right facial weakness (fig 1).

The patient had several normal MRI scans. Previous attempts at treatment with high dose steroids were unsuccessful and the diagnosis was uncertain. With no structural lesion to explain her clinical condition, we suspected muscular or neuromuscular pathology. An unusual presentation of oculopharyngeal dysphagia, ocular myopathies, myasthenia gravis, and mitochondrial myopathies were in the differential diagnoses for this progressive ophthalmoplegia. However, we did not have an explanation for her right facial weakness, which we suspected represented a neuro-pathic process. Further investigations showed normal serum lactic acid and thyroid profile. The blink reflex was normal, excluding the possibility of a cranial neuropathy. Electromyography of the right orbicularis oculi and orbicularis oris showed myopathic features; on the left side it was normal. This suggested an asymmetric facial myopathy. There was no decremental response of the compound muscle action potential, excluding a possible neuromuscular transmission defect. Muscle biopsy from the right quadriceps muscle showed ragged red fibres. Cytochrome C

Figure 1 Observe the wide palpebral fissure on the right, flattening of the right nasolabial fold, and a right exotropia. There was no ptosis of the upper eyelid.

oxidase stains revealed an absence of staining in many fibres, which showed hyperreactivity on succinic dehydrogenase staining. Electron-microscopic examination of muscle tissue showed an increase in the number and size of the mitochondria, especially in subsarcolemmal locations—many showing abnormal crista structure and paracrystalline inclusions. These findings were diagnostic of mitochondrial myopathy. Genetic testing of muscle tissue was positive for a deletion in mitochondrial DNA of about 3.5 kilobases, spanning the ATPase 6 gene to the ND5 gene.

Discussion

Our patient represents a variant of sporadic progressive external ophthalmoplegia with the m-DNA mutation typical of Kearns-Sayre-Daroff syndrome.¹ We were able to find one previous report of this syndrome with a similar clinical presentation.² It was a unique problem because of its atypical clinical features, which presented a challenging diagnosis. This case shows the heterogeneity of the clinical manifestations, course, and tissue involvement in mitochondrial disorders.³ The blink reflex was normal and symmetrical, thus suggesting a non-neuropathic facial weakness, which was confirmed by electromyography. The presentation of this disorder in our patient shows how supranuclear, brain stem, neuropathic, or myopathic abnormalities may be encountered in patients with mitochondrial disorders, either in isolation or in combination. Mitochondriopathies should be included in the differential diagnosis of progressive asymmetric facial palsies, while asymmetrical myopathic facial weakness should be included in the differential diagnosis of infranuclear facial palsies. Our patient's genetic study identified a deletion of mitochondrial DNA in a region that encodes different subunits of the respiratory chain complex. Given the clinical manifestations observed, it is clear that the patient has a significant degree of tissue heteroplasmy.^{4,5}

We would like to emphasise the diagnostic value of the muscle biopsy in cases with atypical clinical presentation and normal serum lactate levels. Genetic testing in blood may become the initial test of choice, with muscle biopsy as an alternative diagnostic aid.

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