detected in any patient by this method. Fourteen patients had raised serum creatine kinase activity (up to 5000 IU/l, normal range < 170 IU/l) and raised serum aspartate transaminase activity (up to 150 IU/l, normal < 35 IU/l). In all cases enzyme activity fell after admission to hospital. Peak serum creatine kinase activity was not significantly related to weight, sex, level of consciousness, or type of surface on which the patient was discovered. Five patients had spent less than six hours on the floor. They had significantly lower peak creatine kinase activity ($p = < 0.02$; Mann-Whitney U test). All except one patient had aciduria (urine pH < 6). Serum creatinine concentration was raised on admission in seven patients but fell later. No patient gave a history of chest pain. Electrocardiographic changes suggestive of recent myocardial infarction were seen in only one. No patient had an abnormal cardiac scan, but in one focal skeletal muscle uptake was related to a site of pressure.

Comment

Raised serum myoglobin concentrations and creatine kinase and aspartate transaminase activities occurred in up to 84% of patients and were related to the period on the floor. Rises in serum muscle enzyme activity were considerable in some patients, with creatine kinase activity reaching 5000 IU/l, but despite long periods on the floor massive levels similar to those that occur when muscle injury is complicated by acute renal failure were not seen. Similarly, raised serum myoglobin concentrations were not very high. Why massive muscle injury occurs sporadically in conditions such as prolonged pressure or unusual exercise remains obscure. Although clearly the insult may be unusually severe, there is possibly a predisposition either extrinsically by an agent such as viral infection[4] or intrinsically by an unrecognised abnormality of muscle metabolism.[5]

Myoglobinuria and clinically important renal injury did not occur at these low levels of myoglobinaemia despite most patients having aciduria and dehydration. Differentiation of myocardial from skeletal muscle injury is clinically important. Raised muscle enzyme activity after a collapse could easily indicate myocardial injury, which may be silent in old people. In our patients raised serum muscle enzyme activity was common, although myocardial injury was probable in only one. Raised serum muscle enzyme activity should therefore be interpreted with caution in diagnosing myocardial infarction in old people who are unable to get up after a fall.

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Rhabdomyolysis and malignant hyperpyrexia

The anaesthetic complication malignant hyperpyrexia occurs in patients who have an underlying muscle membrane disorder. Subjects with this muscle membrane abnormality may also be susceptible to other clinical complications, such as heatstroke[1] and sudden infant death.[2] We report three patients with the muscle disorder predisposing to malignant hyperpyrexia in whom gross rhabdomyolysis was precipitated by severe infection, by alcohol and exercise, and by phenothiazine drugs.

Case reports

Case 1—A 38 year old man of Greek origin was admitted to hospital with bilateral pneumonia and acute renal failure. He complained of severe pain in his calves, and his serum creatine kinase activity reached a peak of 105 000 IU/l on the third day (normal range 10-150 IU/l). He was treated with intravenous penicillin and oral erythromycin and gradually improved. He required haemodialysis for 19 days for four to five hours a day. When he was discharged on the 30th day his chest was clear and his renal function normal. A fluorescent antibody test showed a rising IgM titre to 1/512, diagnostic of legionnaires' disease. He was readmitted for elective muscle biopsy two and a half months later. He appeared fit and well and clinical examination showed nothing abnormal. Serum creatine kinase activity was 113 IU/l. In vitro muscle contracture studies gave results typical of those seen in patients susceptible to malignant hyperpyrexia. The 1% halothane contracture was 0·2 g and the 2 mM caffeine contracture 0·2 g.

Case 2—A 35 year old man gave a six year history of severe muscle pains for one or two days after playing squash or drinking moderate amounts of alcohol. Clinical examination showed no abnormality but serum creatine kinase activity ranged from 500 to 1600 IU/l. In vitro muscle tests gave the characteristic responses seen in patients susceptible to malignant hyperpyrexia. The 1% halothane contracture was 0·5 g and the 2 mM caffeine contracture 0·6 g. His father and one sister also had positive in vitro muscle contracture responses.

Case 3—A 31 year old man had been treated with fluphenazine by mouth and intramuscularly for nine months for chronic schizophrenia. He became nauseated and drowsy, developed a temperature of 38·5°C, and had a grand mal fit. Examination showed no neurological abnormality but his serum creatine kinase activity was 53 000 IU/l and the urine contained myoglobin. The neuroleptic malignant syndrome was diagnosed and the phenothiazine treatment stopped. Two months later, when he was fully recovered from this episode and his creatine kinase activity was normal (87 IU/l), results of in vitro muscle tests were diagnostic of susceptibility to malignant hyperpyrexia. The 1% halothane contracture was 0·45 g and the 2 mM caffeine contracture 0·4 g. His brother also had positive muscle contracture responses.

Comment

Severe sepsis has recently been emphasised as a possible cause of rhabdomyolysis,[3] and the findings in our case 1 suggest that this may occur in patients with the underlying muscle membrane disorder that predisposes to malignant hyperpyrexia. The second case indicates that alcohol and exercise may also trigger rhabdomyolysis in these susceptible people. The third case provides further evidence of an association between malignant hyperpyrexia and the neuroleptic malignant syndrome.[4] This second condition, an uncommon but dangerous complication of treatment with neuroleptic drugs, is associated with rhabdomyolysis and clinically resembles malignant hyperpyrexia.

These case reports have therapeutic implications, as dantrolene sodium—a specific treatment for malignant hyperpyrexia[5]—may be useful[1 4] in patients with severe rhabdomyolysis resulting from non-anaesthetic triggers.

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