ABnormally high regional oxygen consumption in malignant hyperthermia patients induced by a non-anesthetic stress (10 minute tourniquet ischemia to the upper extremity).

In an effort to develop a non-invasive screening test for malignant hyperthermia, we measured the amplitude of evoked thumb adduction in response to ulnar nerve stimulation before, during, and after tourniquet occlusion to the upper extremity. A tourniquet was selected as the means of inducing the stress since a tourniquet test has been shown useful to detect low serum calcium concentration, i.e. the Trousseau sign. Also, abnormal calcium binding of muscle has been described as diagnostic of the syndrome.

Method. 50 subjects (23 females and 27 males) ranging in age from 8 to 63 years of age were studied. They were divided into two groups: Group I - 15 patients, either biopsy positive, or a survivor of malignant hyperthermia syndrome and Group II - 35 healthy controls with no personal or family history of MH. Informed consent was obtained from all participants.

Neuromuscular function was evaluated by measuring evoked thumb adduction using a Grass FT-10 force transducer and a Grass polygraph. Supramaximal square wave pulses of 0.2 msec duration were applied to the ulnar nerve at the wrist via two surface electrodes at a frequency of 0.1 Hz. A Grass S-88 stimulator and an SIU-5 stimulus isolation unit were used. After establishing a stable control twitch height, a tourniquet applied to the upper arm was inflated to a pressure of 250 Torr for 10 minutes. The evoked twitch response during the control period was measured and compared with the response during and following tourniquet cuff inflation.

Three blood samples were collected from each of 12 subjects (6 control and 6 positive for MH) through a 20 gauge catheter placed in the antecubital vein below the tourniquet. Heparinized samples were taken before tourniquet application, and at 5 and 10 minutes during tourniquet occlusion, and analyzed for oxygen content (VOL% 02) in an IL 282 CO-Oximeter.

Results. Figure 1 illustrates % decrease in venous oxygen content at 5 and 10 minutes of ischemia. Solid dots represent patients with a positive tourniquet test, and either a positive muscle biopsy, or a history of having survived the syndrome. Open circles represent control subjects. At 10 minutes there was a 23% decrease in oxygen content in control venous blood while the MH positive patients decreased by 39%. Venous oxygen content was statistically lower in the MH positive group.

Discussion. Both positive and normal tourniquet test results are shown in Figure 2. (Upper tracing (MH patient) shows marked twitch response at 2 minutes post tourniquet release. Lower tracing (control subject) shows slight depression of twitch amplitude at 2 minutes post release). 85% of patients with a positive tourniquet test have a positive muscle biopsy. With a negative tourniquet test, correlation with biopsy was 60%. Britt reported a 100% correlation of tourniquet test with biopsy if twitch height rises 80% or more immediately post tourniquet release. The tourniquet test is helpful when positive, but it would be useful if the tourniquet test could be more precise. Oxygen consumption during tourniquet ischemia points to a non-anesthetic induced increase in regional metabolism in MH patients.

Figure 2.

References.