INTRODUCTION

When performing a nerve block the anesthesiologist is required to blindly place an electrical stimulating needle, into three different nerves in the infraclavicular region below the shoulder. The needle placement is aided by visualizing the nerves and the needle in 2-D using an ultrasound. Coordination of both the ultrasound transducer and the needle requires intense studying of the ultrasound image on a screen. The needles correct placement onto a nerve is confirmed when the electrical current through the needle activates a contraction in the corresponding muscle. The nerve stimulator emits an electrical pulse of 0.4 mAmp at 1Hz.

The anesthesiologist’s big problem is that he/she is required to look away from the ultrasound screen to the limb to identify the muscle twitching. During this time the needle may displace. An ideal situation would be if a muscle twitch indicator could be placed immediately next to the ultrasound screen for simultaneous viewing of the ultrasound-image and a muscle twitch indicator (the RAPTI). This project is to design and manufacture a muscle twitch monitor using a phonomyogram.

DEVICE DESIGN

The device should have 6 piezo-electric microphones taped to the skin over each muscle of interest. The received signals will need to be amplified, and filtered against noise. An independent nerve stimulator (0.4 mAmp 1 Hz pulses) will be used to stimulate the nerves via a needle, to induce muscle twitches. The arm under study will be relatively mobile (source of noise). It is hoped specific muscle twitches can be identified and displayed. It is unknown how much noise one muscle twitch or other movement of the arm will cause at a second muscle under examination but not twitching.

The muscle twitch signals should be displayed in a vertical linear form either as a bar of varying height on an LCD screen (figure 3) or as series of different color LED lights one above the other (figure 2). The height of the bar (or number of LED lights should indicate a crude grade of muscle contraction (small, medium, or large) for each specific muscle. The target muscles would be (1) flexor carpi ulnaris, (2) Biceps, (3) Deltoid, (4) triceps, (5) brachioradialis, and (6) pectoral.

Figure 1 indicates the arrangement of the nerve stimulator for the needle and the muscle twitch monitor. “A” is the phonomyogram, and “B” is the anesthesiologist nerve stimulator attached to a needle on the nerve. Correct interpretation of the muscle twitching will be easy provided it can seen which muscle twitches dominantly even if the other muscles indicate slight “activity” due to artifact signals.

Other research teams using phonomyography used a 1.6 cm diameter Model 1010 Grass instruments 2.5 to 5 kHz frequency response, 20 to 40 mV into 1 MQ piezoelectric microphone, amplified and band pass filtered between 0.5 100Hz using a AC/DC amplifier. Their project assessed one muscle only in a secured immobile arm and their objective was to grade the exact MAGNITUDE of muscle contraction. This new project needs only to identify WHICH muscle is contracting.

FINAL COMMENT

The system could designed as a FOUR channel system if practicalities made this significantly easier to manufacture, although SIX channels will be preferred.