COMPARING THE PARAMETERS OF H-REFLEX BY ELECTRICAL AND MAGNETIC STIMULATION

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Abstract: Electrical stimulation is widely used to stimulate neuromuscular system but pain, erythma, burns and limited penetration depth are some disadvantages of electrical stimulation. In the other hand magnetic stimulator provide a unique advantage, they do not require electrodes so it is a proper method for stimulating neuromuscular system and had no pain, burn and uncomfortable feelings. In this study we tried to compare the H-reflex and M wave parameters evoked by electrical and magnetic stimulation. Three volunteer healthy men participated in this study they were tested in three different testing sessions. In each session H-reflex was evoked with three different stimulus intensities. The results showed that the values of the magnetic and electric H-reflex parameters are similar and magnetic H-reflex parameters are reliable for multi-sessions tests.

Introduction

Sometimes evoking of H-reflex with electrical stimulation is accompanied by some side effects of electrical stimulation such as pain, burning, discomfort for patients, especially in high stimulation intensities [1]. This problem can affect the general state of the patients and may have adverse effects on H-reflex parameters, which can mislead the researchers; but magnetic stimulation can easily penetrate to the tissue and doesn't make high density of current in the skin, so no pain or discomfort happens. In addition there is no need to tight attachment of the coil to the skin [1]. Magnetic stimulation can stimulate lumbosacral roots and deep nerves like sciatic nerve easily [2]. Magnetic stimulation is effective in pain management of shoulder rotator cuff and carpal tunnel syndrome [3]. In the field of neurological disease, transcranial magnetic stimulation was shown to be effective in temporary reduction in the symptoms of Multiple sclerosis and Parkinson diseases. Magnetic stimulation had been successfully used in psychological disorders, bone fractures, wound healing, incontinence, muscle atrophy and as a diagnostic tool in neurological disease [3, 4, 5]. This study is dealing with application of Magnetic stimulation as a diagnostic tool in peripheral nerve disease. So it tries to compare the parameters of magnetically evoked H-reflex with H-reflex parameters evoked by conventional electrically stimulation and test the reliability of magnetically evoked H-reflex parameters.

Materials and Methods

Three healthy volunteer men participated in this study. The tests were performed in three different days. In each testing session H-reflex was elicited with electrical stimulation and then with magnetic stimulation. The same tests were done in other sessions to assess the reliability of H-reflex parameters. In each session H-reflex was elicited with three different stimulus intensity, one of them was the intensity needed to evoke maximum H response (Hmax) and two others were 20% more and 10% less than that needed to evoke Hmax.

H-reflex were elicited by isolated rectangular pulses, with 700 microseconds width and 0.2 Hz frequency delivered to the posterior tibial nerve in popliteal fossa between semimembranosus and biceps femoris tendons. H-reflex recording electrodes (Ag-AgCl) were placed over soleus muscle as recommended in the texts [5,6]. Stimulus amplitude was set manually; computer set pulse width and frequency. The ground electrode was an Ag-AgCl surface strip, wrapped between recording and stimulating electrodes. Arrangement of the recording electrodes was the same as previously described for electrical stimulation.

Magnetic stimulus was delivered via a 25mm double coil with maximum 4T field strength by magnetic stimulator.

Myoelectric signals were amplified with an electromyogram amplifier.

Stimulus generation and response sampling were controlled using a multiple function input-output board plugged in an IBM-compatible PC 486-DX2-66 and software written in Borland C++. Data were sampled at 10 kHz with a 12bit analog to digital converter.

Five successive recorded H-reflex signals were averaged and the parameters of the averaged signal were calculated.

Results

Collected data was analyzed using Chi-square and Man-whitney tests by SPSS statistical software.

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Peak to peak amplitude, latency and duration of H-reflex and M wave were recorded in three different stimulation intensities. No significant difference was found between electrical and magnetic H-reflex and M wave parameters in different intensities (P>0.05) (Figure 1) (Table 1).

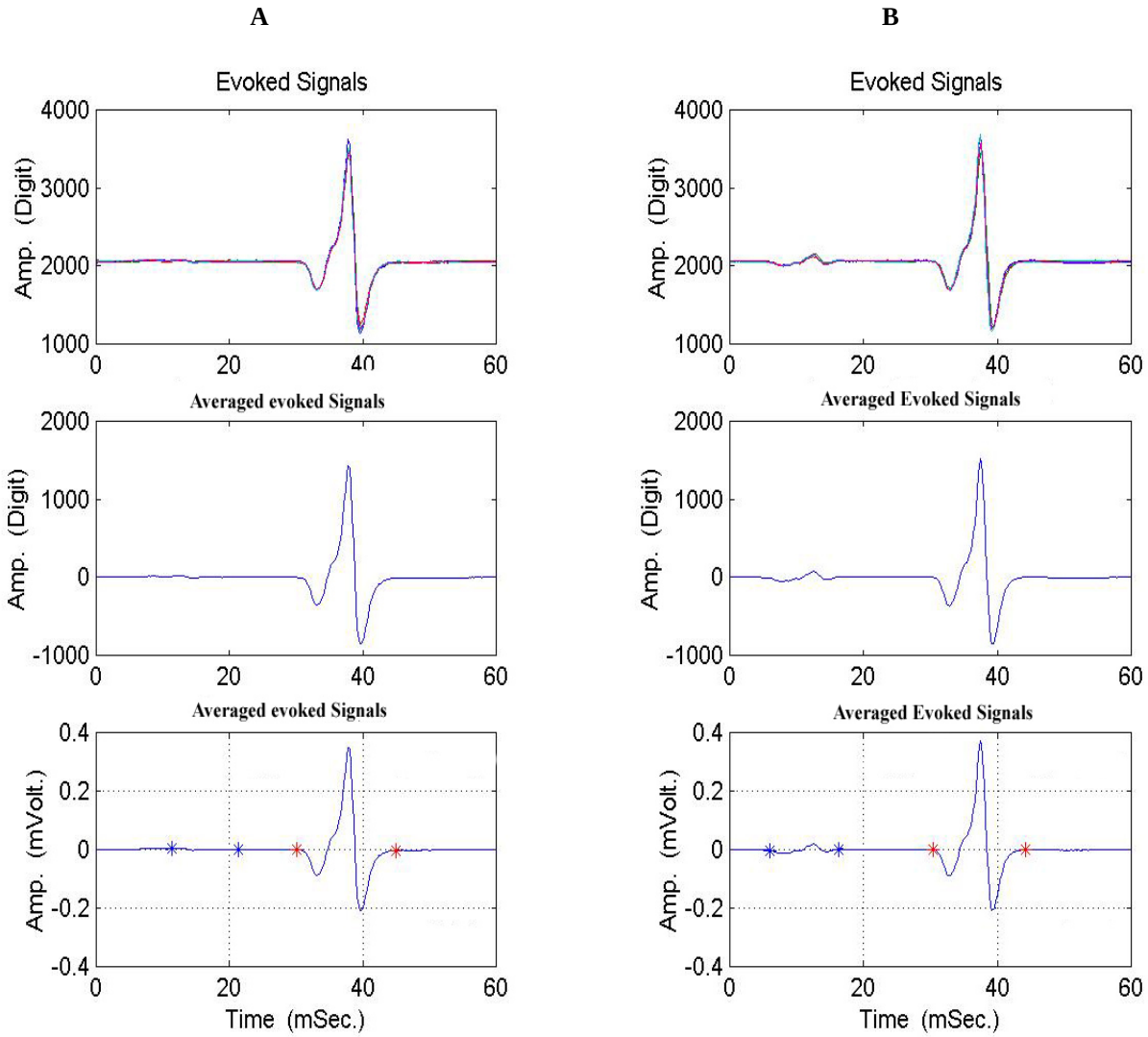

Figure 1: Samples of electrically(A) and magnetically(B) evoked Hmax.

To assess the reliability of the H-reflex and M-wave parameters evoked by magnetic stimulation were recorded in three different sessions. The mean values of peak to peak amplitude of Hmax were 4.68±2.05, 4.10±.93, 4.13±2.29 in three sessions respectively which were not significantly different (P>0.05). Latency and duration of Hmax in different sessions were not significantly different (P>0.05) (Figure 2 A, B, C).

In other stimulation intensities (20% more and 10% less than the stimulus intensity needed to evoke Hmax) the parameters of H-reflex and M wave were not significantly different in different testing sessions (P>0.05).

The results of electrically evoked H-reflex were the same as magnetic stimulation.

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Table 1: Electrically and magnetically evoked H-reflex parametrs in different intensities.

Intensity	Hmax		20% more tham Hmax		10% Less than Hmax	
	electrically	magnetically	electrically	magnetically	electrically	magnetically
Peak to peak H_{max}(mV)	5.7±.9	4.41±.99	4.39±1.07	3.67±.99	3.86±.82	1.44±.61
Latency(mS)	26.16±.69	26.6±.65	22.83±3.9	26.42±.54	27.5±.69	28.1±1.27
Duration(mS)	12.9±5.08	12.11±.47	12.28±.62	11.7±.7	12.51±62	11.4±.59

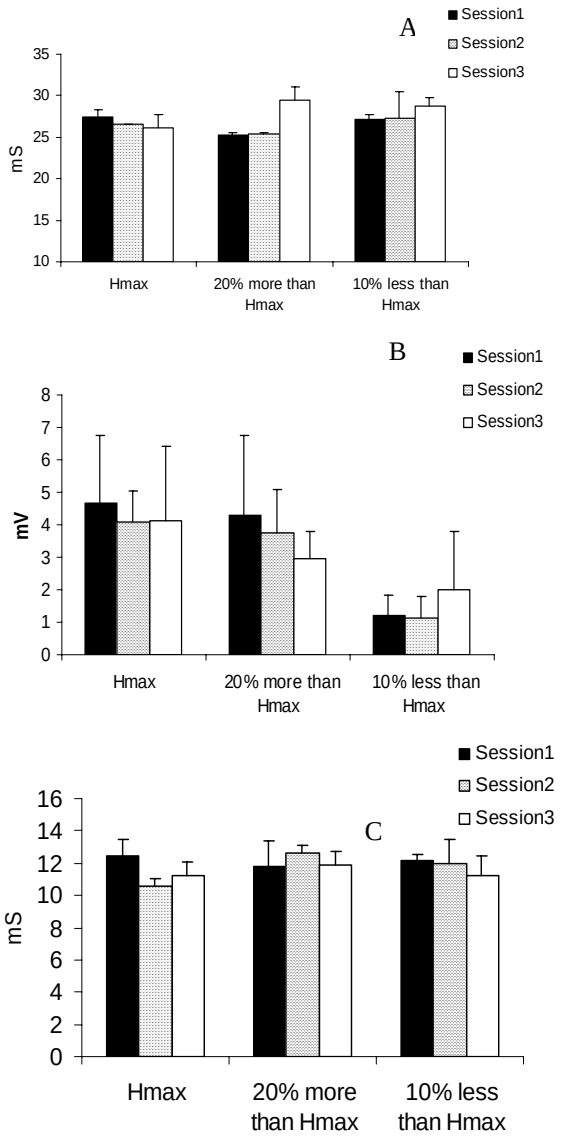

Figure 2: latency (A), Peak to peak (B) and Duration(C) of H-reflex in different sessions and intensities.

Discussion

H-reflex parameters were compared in electrical and magnetic stimulation methods and the reliability of these parameters in magnetic H-reflex was studied. Previous reports stated that Ia afferents can be stimulated in a nerve trunk by magnetic stimulation [2]. The results showed that there was no difference between latency of electrical and magnetic H-reflex. Equal latency in these two methods shows that the stimulated fibers in both methods are the same and obviously are thick Ia afferent fibers. This finding was confirmed by other studies [2, 7].

No difference in H-reflex parameters in three different testing sessions shows that magnetic H-reflex parameters are reliable and the stimulated fibers in different sessions are approximately the same.

Magnetic stimulation mostly excite thick fibers like Ia fibers so thin fibers like pain afferents are less likely to be excited. This phenamenon make magnetic stimulation more comfortable for the patients[2, 8].

Peak to peak amplitude of H-reflex is related to the number of activated motor-neurons. In this study the peak to peak amplitude of Hmax in both methods were alike and shows similar functionality of theses two methods but this finding is different from a previous study which reported peak to peak amplitude of magnetic Hmax being 40 to 60 percent of electrical Hmax[2]. Of course this can be related to the different stimulators and coils.

Conclusions

According to the advantages of magnetic stimulation, the electrical stimulation can be replaced with magnetic stimulation to evoke the H-reflex.

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