Normative Data of Needle Electromyography, What Is Different in Iraqi Patients?

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ABSTRACT:

BACKGROUND:

The electrodiagnostic studies are useful adjuncts to the clinical examination of the peripheral nervous system. Electromyography (EMG) records the physiologic status of muscle function. Needle electromyography help localize abnormalities along peripheral nerves or lower motor neurons.

OBJECTIVE:

To establish the normal electrophysiological values of the common upper and lower limbs muscles in sample of healthy adult population in Iraq using standard temperature control, and to compare with those data published in other studies.

MATERIAL AND METHODS:

This is a cross sectional study conducted in Al-Kadhmiya Teaching Hospital during the period from July 2008 to December 2009. The study included 43 healthy individuals, aged 20-50 years (15 women and 28 men). Using the standardized technique, underwent electrophysiological studies for EMG studies for the commonly tested muscles.

RESULTS:

Forty-three individuals (include15 women and 28 men) participated in the study, and conventional EMG successfully done with good cooperation. EMG parameters results corresponded with those previously published in other studies.

CONCLUSION:

This study helps establish the normative electrophysiological parameters of the commonly tested muscles in the upper and lower limbs for our EMG laboratory in Iraq. The results compared favorably with existing literature data.

***KEY WORDS*: **electromyography

INTRODUCTION:

The electrodiagnostic studies, consisting of nerve conduction studies and needle EMG, is a useful adjunct to the clinical examination of the peripheral nervous system. EMG records the intrinsic electrical activity of muscle fibers, thus providing the physiologic status of muscle function. To interpret the electrodiagnostic study results, the clinician must understand the anatomic and physiologic basis of the studies [(1)].

Needle EMG is used to study the physiologic status of muscle function [(2)]. With EMG, a needle electrode is used to measure the intrinsic electrical activity of muscle fibers. The needle EMG study has three components: observation of muscle at rest, Motor unit action potential (MUAP) on minimal voluntary contraction, and the recruitment pattern of MUAP s on maximal contraction. At rest, the muscle should be electromyographically quiet [(1)].

The motor unit is the smallest functional unit of the muscle which can be voluntarily activated[3] and consists of an anterior horn cell, its axon and all the muscle fibers it innervates[(4)].

The electromyographic examination used to record the electrical activity of skeletal muscle, usually is performed in four steps [(5)].

- A concentric needle electrode is placed in the muscle and the electrical activity associated with its insertion is evaluated (insertional activity).

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- The muscle is evaluated at rest, that is, when the needle is stationary in a relaxed muscle (spontaneous activity).
- Muscle potentials evoked by isolated discharges of motor neuron are recorded with mild voluntary contraction of the muscle (motor unit potentials).
- The change in electrical potential is assessed as the level of muscle contraction gradually increases and reaches a maximum (recruitment and interference pattern).

Insertional activity is the electrical response of muscle membrane to insertion of the EMG needle. Increased insertional activity, or persistent abnormal spontaneous electrical activity, is secondary to a hyperexcitable muscle membrane. Decreased insertional activity can be associated with muscle fibrosis, fatty replacement of the muscle, muscle paralysis, or myopathy [(1)]. Normally, this activity is of short duration, 300ms [(6)].

The classical method of motor unit potential measurement is the isolation and recording of at least twenty single potentials and then the manual measurement of their amplitude, duration and number of phases [5]. Figure 1

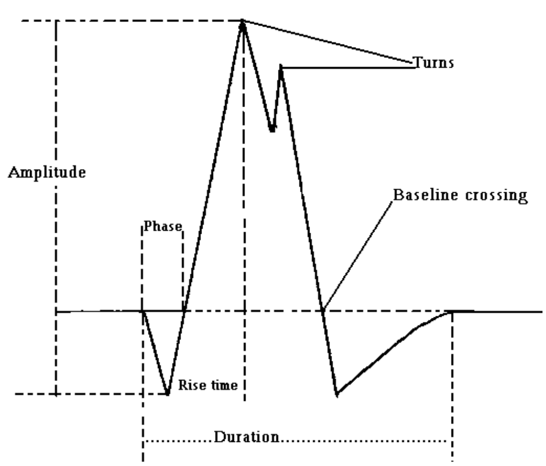

Figure 1: Motor unit potential measurements

A phase is defined as that portion of a wave between the departure from and return to baseline. The number of phases is determined by counting the number of negative and positive peaks to and from the baseline and is equal to the number of baseline crossing plus one [(7)]. Polyphasic potentials have more than four phases and do not normally exceed 5–15 % of the total population of MUAPs in a healthy muscle[(8)].Interference Pattern is the electrical activity recorded from a muscle with a needle electrode during full effort [(9)].

A full or complete interference pattern implies that no individual motor unit potential can be identified. Recruitment is said to be normal when complete interference pattern occurs with maximal effort [(5)].

The amplitude of a normal interference pattern is quite variable, usually between 2 to 4mVs. It is measured from the envelop curves by the negative and positive peaks, excluding high solitary peaks [10]. A reduced or incomplete interference pattern occurs when some of the individual motor unit action potentials may be identified while others cannot because of overlapping. A discrete pattern implies that each of the MUAP can be identified with rapid firing rates during maximal effort. Finally, the term single unit pattern (single oscillation) is used to describe a single unit firing at rapid rates during maximal voluntary effort [11]

Several factors can influence the MUAP, including: the type of needle used (monopolar versus concentric), needle position, temperature, muscle type, and age (MUAP duration and amplitude increase with age).[5]

MATERIAL AND METHODS:

We conducted a cross-sectional study on 43 individuals. Tests were done at Al-Kadhmiya Teaching Hospital during the period July 2008 to December 2009. The study included 43 healthy individuals, aged 20-50 years (15 women and 28 men), selected after giving their consent to participate. Subjects had no history of systemic or neurological disease, and whose neurological examination was normal. Blood tests, including blood sugar, electrolytes and renal function were done too, and only subjects with normal results were chosen to undergo the study.

Individuals with history of alcohol abuse or medications that may affect the results and those with history of diabetes or hypothyroidism were excluded. Those above the age of 50 were excluded too.

Ethical Approval and the informed consent approved by the central ethical committee of Alnahrain college of medicine.

EMG studies of right and left deltoid ,biceps,triceps, abductor polices brevis, abductor digitiminimi, tibialis anterior, extensor digitorum brevis, vastus medialus and gastrocnemius muscles.

The room temperature was monitored and kept between 25– 28C^0 during the test procedures, and skin temperature was stabilized between 32-35 C0.

A standardized technique was used.

An 8-channel electromyography machine (Micromed) was used for all the electrophysiological analysis of muscle activities.

Grounding electrode (to protect the subject against any electrical hazard and to reduce artifact) and disposable concentric needle electrode (size 0.045×38mm). Before application of these electrodes the skin was cleaned with alcohol swabs. Bipolar needle cable, EMG-needle cable, Microtone adhesive cream for EMG, measuring tape, and a thermometer.

Needle examination was performed as follows

1. Identifying the muscle by palpation during contraction to confirm its location.
2. Inserting the needle when the muscle is at rest in order to study the insertional activity, the gain setting was 50 to 100 microvolts/cm and a sweep speed of 5 –10msec/cm. Filter setting was 20Hz to 10 KHz
3. The muscles were studied at rest to detect spontaneous activity. The gain was increased to increase the sensitivity.
4. Minimal or mild muscle contraction. Motor units potential were evaluated when the minimal muscle contraction activated 3–6 motor units. The gain was set at 200 microvolt/cm. Twenty or more single motor unit potentials were isolated all of them with an amplitude of more than 50µv. Duration, amplitude, and polyphasia were studies. Since the needle electrode records activity primarily from a small area in the muscle, several sites were examined with a single needle puncture by advancing or withdrawing the needle in small steps and changing the direction of the needle two or three times.
5. Maximal contraction in order to study the recruitment pattern.

Data were processed using the Statistical Package for Social Sciences (SPSS) version 10.0 Descriptive statistics for the continuous variables included the mean and the standard deviation. For each parameter, the mean values and standard deviations (SD) were calculated.

RESULTS:

43 individuals participated in the study that had done conventional EMG successfully with good cooperation.

The parameters that have been studied at rest are the insertional activities and spontaneous activities, while during those voluntary contractions included duration, amplitude, percentage of polyphasia of MUP, as well as the interference pattern.

Needle EMG findings of Deltoid, Biceps, Triceps, Abductor pollicis brevis and Abductor digiti minimi muscles in the upper limbs (Table1) and Extensor digitorumbrevis, vastusmedialus, Gastrocnemius, and Tibialis anterior muscles in the lower limbs (table2) are shown below. Values will be mentioned as mean±SD.

Table 1: Needle EMG finding of upper limb muscles.

EMG finding	Deltoid	Biceps	Triceps	Abductor pollicibrevis	Abductor digitiminimi
Insertional Activity	Normal	Normal	Normal	Normal	Normal
Spontaneous activity	Absent	Absent	Absent	Absent	Absent
Duration of MUAP (mean ±SD) (msec)	10.9 ±46	10.49 ±1.77	12±0.27	9.27±0.23	9.30±0.23
Amplitude of MUAP (mean ±SD) (μV)	175±36	158±36	227±42	180±33	187±30
Polyphasic potential (%)	< 15%	< 15%	< 15%	< 15%	< 15%
Interference Pattern	Full	Full	Full	Full	Full

Table 2: Needle EMG finding of the lower limb muscles.

EMG finding	Extensor digitorumbrevis	Vastusmedialus	Gastronomies	Tibialis anterior
Insertional Activity	Normal	Normal	Normal	Normal
Spontaneous activity	Absent	Absent	Absent	Absent
Duration of MUAP (mean ±SD) (mSec)	10.03±0.46	10.87±0.48	10.17±0.48	12.95±0.93
Amplitude of MUAP (mean ±SD) (μV)	163±25	175±43	132±38	154±39
Polyphasic potential %	< 15%	< 15%	< 15%	< 15%
Interference Pattern	Full	Full	Full	Full

DISCUSSION:

This study can greatly attribute to establishing the normative electrophysiological parameters of the commonly tested muscles in the upper and lower limbs for our electromyography laboratories in Iraq. The results compared favorably with existing literature data.

To our extent of knowledge, few, if any studies, had been conducted in our country to investigate the normal values for electromyography parameters in the Iraqi population, and whether or not there are any differences in these values.

This study examined the the needle EMG parameter of commonly tested muscles in the upper and lower limbs of a sample of healthy adult population in Iraq to provide normative and reference values in our EMG lab in the country.

A comparison was made between this study and other studies published in the literatures, and since numerous studies have been published, the few were chosen that used standardized techniques and recorded limb temperature and age of the subjects.

The mean durations of the tested muscles, for deltoid, biceps, triceps, abductor policis brevis, abductor digiti minimi, extensor digitorum brevis, vastus medialis, gastrocnemeus and tibialis anterior were 10.9±0.46, 10.49±1.77, 12.0.27, 9.27±0.23, 9.9.30±0.23, 10.03±0.46, 10.87±0.48, 10.17±0.48 and 12.95±0.93mSec respectively and these values agree with those reported by Buchthal[10], while they were lower than the biceps and tibialis anterior duration reported by Joe et al[(12)], this could be due to several reasons. First, the different maneuvering, setting and recording the electrical response and secondly the duration can be measured more accurately from the computer screen than manually from film.

The mean amplitudes of MUAP of the tested muscles, for deltoid, biceps, triceps, abductor policis brevis, abductor digiti minimi, extensor digitorum brevis, vastus medialis, gastrocnemeus and tibialis anterior are 175±36, 158±36, 227±42, 180±33, 187±30, 163±25, 175±43, 132±38 and 154±39 μV respectively and these values in closely approaching those of Buchthal[10] and Stalberg[(13)], and lower than Joe et al[(12)] in regards to the biceps and tibialis anterior.

The lower mean values are still within normal as the mean amplitude can differ very widely in the various recordings. The large variability of the amplitude when compared with Joe et al[(12)] is probably the reason why amplitude has rarely been considered in previous studies [(10)]; besides, the difference in the amplitude may be attributed to the difference in age groups in other studies, especially when considering that the amplitude increases after the age of 60 years[(13)]. Table3 shows the comparison of current study with those reported by others.

There is no significant change of MUAP amplitude that can be found for subjects between 20 and 50 years of age. Regarding polyphasia, it's found in<15% in all tested muscles and the interference pattern shows full recruitment in all tested muscles.

Our study has its limitations and challenges. First, this is a cross sectional study, which means it is a snapshot of those parameters, so we did not follow up the subjects and see how time affects serial measurements (if ever). Secondly, although our sample size was similar to that of other studies, it is still relatively small. This might have contributed to the large standard deviation values seen occasionally in our results. The selection process might have also resulted in selection (response) bias as the subjects were chosen from those who responded to the ad we placed, so the true representativeness of our sample is not fully guaranteed.

The challenges we faced in our study can help future researchers and investigators to come up with study designs that can probably overcome those obstacle. We suggest a couple of points that might be of help here:

1. Studying larger samples that are randomly chosen. This can help obtain results that are more accurate (smaller standard deviations), and that are more representative of the general population.
2. Further studies focusing on the amplitude of MUAP to broaden the data base and reduce the large variability among the results.
3. Further EMG studies with a special focus on age extremities. Our study included those who are 20-50 years of age. Studying younger and older populations can aid detect any differences in the normal values (if any). It can also help us know how generalizable our results are to the Iraqi population as a whole.
4. Studying samples of people with different preexisting conditions (such as diabetes and renal failure) that can theoretically affect electrophysiological study results, and see how the changes in our population compare to those of other nations worldwide.

Table 3: Comparison of Needle EMG finding (amplitude and duration) between the present study and those reported by others (duration in mSec, and amplitude in µV).

Muscle	EMG Parameters	Present study Mean (SD)	Buchthal[10] Mean	JOE F.[12] Mean (SD)	Stalberg[13] Range
Deltoid	Duration	10.9 (0.46)	10.2-11.6		
	Amplitude	175 (36)	212		
Biceps	Duration	10.49 (1.77)	10.0-11.4	20.68(5.26)	
	Amplitude	158 (36)	180	315.17 (166.74)	65-180
Triceps	Duration	12 (0.27)	11.6-12.4		
	Amplitude	227 (42)	340		
AbductorPollici Brevis	Duration	9.27 (0.23)	9.2-9.4		
	Amplitude	180 (33)	260		
AbductorDigitiminimi	Duration	9.30 (0.23)	9.2-9.4		
	Amplitude	187 (30)	350		
Extensor digitorum brevis	Duration	10.03 (0.46)	9.4-10.7		
	Amplitude	163 (25)	210		
Vastusmedialus	Duration	10.87 (0.48)	10.2-11.6		
	Amplitude	175 (43)	230		
Gastrocnemeus	Duration	10.17 (0.48)	9.4-10.7		
	Amplitude	132 (38)	160		
Tibialis anterior	Duration	12.95 (0.93)	12.3-14.0	19.38 (5.55)	
	Amplitude	154 (39)	220	270.35 (152.69)	65-330

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