Original article

Role of Electromyography(EMG) for (Muscle Conductivity) management of Paralyzed Patients in Dhaka city

DOI: https://doi.org/10.47648/zhswmcj.2021.v0302.03

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Abstract

The purpose of this study is to assess the electromyography (EMG) signals of biceps muscle of paralyzed patients to know the condition of their affected muscle. For measuring the muscle signal, 5 voltages analog signal is sent to biceps muscle via EMG sensor with Arduino. As higher the voltage is, the condition of the muscle status is better. In this study, we have observed paralyzed patients in Dhaka city having different kinds of paralysis patients like Complete paralysis, Partial or incomplete paralysis and localized paralysis. The study also focused on monitoring different stage of paralysis like Flaccidity, dealing with appearance of spasticity, increased spasticity or decreased spasticity, complex movement combination, spasticity disappear and normal function return. This observational study was carried out in three largest and tertiary care hospitals located in Dhaka metropolitan area with the help of Myoware EMG based muscle sensor. Total 50 paralyzed cases were included in this study. Among the 50 cases of paralyzed patients, majority of the cases (55%) were of 40-55 years aged group where 75% were male and 25% were female. In this study, 85% were Localized paralyzed patients, 10% Partial paralyzed and 5% Complete paralyzed. This study also shows the condition of healthy biceps muscle as compared with paralyzed muscle. The findings of this study could play an important role to observe the condition of paralyzed muscle for better management of paralyzed patients and give a clear idea about which management is needed.

Keywords: Paralyzed Muscle, Electromyography (EMG), Muscle Fiber, Muscle Signal.

Introduction

Electromyography (EMG) measures the electric signals of the muscle when it contracts. Electromyography (EMG) is the technique for measuring the electrical movement inside muscle filaments during movements.[1] Create the progress in measuring and preparing advancement have of wearable devices for a wide scope of uses, including Human-Computer collaboration. A little device size is required for such kinds of work to be effective in receiving, presenting severe imperatives on their specialized determinations. Determination of natural sign, for example, Electromyography(EMG), is a difficult application for such wearable gadgets. The sign of wave has an exceptionally low sufficiency and are influenced by high commotion aggravations. EMG sign determined the client's lower arm can be utilized to perceive hand motions, with application in regular cooperation and hand prosthesis control. Each time when muscle moves, muscle fibers are activated with the signals come from the brain, through the central sensory system and neurons, to the muscle filaments. There are usually more negative charges inside the muscle cell than the outside, until a positive potential signal goes along through the length of the muscle fiber when a muscle contracts.[2] EMG estimate this active potential signal going down through the muscle fiber at a speed of 2-6 m/s. [3] By finding the gestures of muscle, a doctor can easily compare the reports between a healthy arm and a paralyzed arm and the condition of the paralyzed arm. From this study, condition of the paralyzed muscle can be measured gradually. Thus, the making costs are so low people can easily do EMG test and can know about their condition of muscle tone. There is no such of limitations of it. Only if the sensor does not work out due to electrical problems.

Approximately 10 percent of the Bangladesh population or 16 million peoples reported they were living with some sorts of paralysis, defined by the study as a central nervous system disorder resulting in difficulty or inability to move the upper or lower extremities.[4] The leading cause of paralysis was stroke (33.7%), followed by spinal cord injury (27.3%) and multiple sclerosis (18.6%).[5] The three main nerves in the hand are ulnar, radial and median nervesand each serves a different part of the hand. Damage to one or more of these nerves can result in hand paralysis. Although paralysis is typically

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characterized by lack of movement, some forms of paralysis, called palsies, cause uncontrollable movement. There is no cure for this orthopedic condition; however, in some cases, partial muscle control or feeling may return after treating the cause of the paralysis, which might involve: Physical**, Occupational therapy** , **Mobility aids** , **Adaptive equipment**.[6] There are 7 stages of developing a muscle signal, from paralyzed to normal thus as Flaccidity dealing with appearance of spasticity, increased spasticity, decreased spasticity, complex movement combination, spasticity decapper and normal function return.[7] But it's not unusual that some paralyzed patients can't recover from their penalization.

Materials and Methods

This observational study was carried out in the three tertiary care hospitals in Dhaka metropolitan area named Neuro Science Institute& Hospital, Dhaka Medical College Hospital and AMZ Hospitals as they were treating different types of paralyzed patients. The study was conducted 25th November 2019 to 2 February 2020 using the EMG based muscle sensor. The study population were 50 paralyzed patients with different stages of paralysis. We excluded patient under the age of 30 years and patients operated in the Obstetrical & gynecological department.

Some operational definition, in this study EMG sensor gives results based on given 5 Voltage. As higher the voltage is, the condition of the muscle status is better. By this output signal receiving data is compared the muscle condition of the paralyzed patient with that standard situation of muscle. This device works is based on three electrodes where one electrode is placed in the middle of targeted muscle body, another one is placed at one end of the muscle body and third electrode is placed on a bony or non-muscular part of the body near the targeted muscle. In this study, different types of variables evaluated like muscle tension of different types of paralysis, muscle tension at different stage of recovery, comparison of muscle tension paralyzed vs normal people, average signal of paralyzed people varies with age, types of patient according to gender like male, female and others.

Detailed information was obtained in each case. Complete history of paralyzing the muscle was taken from patients through practical examination. Relevant investigation and operational notes were collected. All the information was recorded on a fixed dataset. Collected data was classified, edited, coded and entrusted into the computer for statistical analysis by using Microsoft Excel, Microsoft word and Arduino IDO.

Results

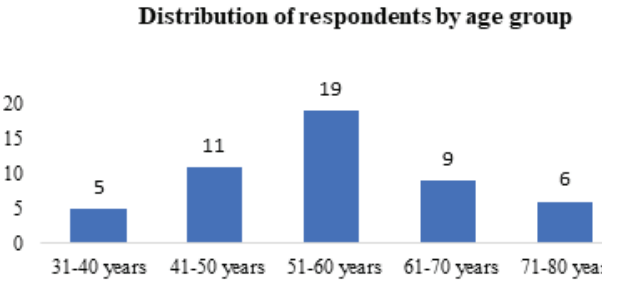

Figure1: Age distribution of the study population

Figure shows age group distribution of the study population, 19 of the cases were of 51-60 years age group, 11 of the cases were 41-50 years, 9 of the cases were 61-70 years, 6 of the cases were 71-80 years and 5 0f the cases are 31-40 years

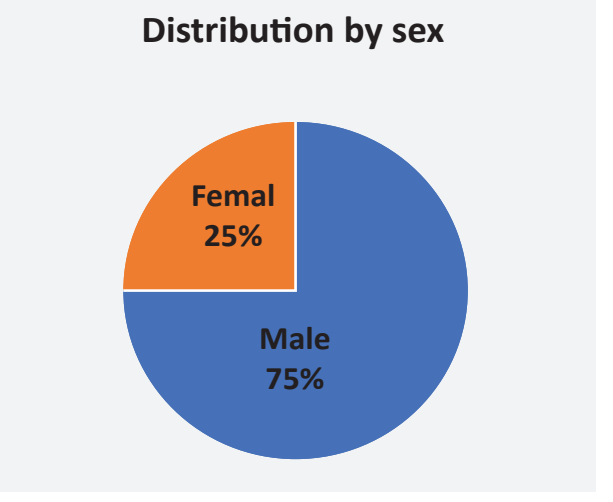

Figure 2: Sex distribution of the patient

Figure 2 shows that most of the cases were male of 75% and female of 25%.

Table1: Average EMG signal based on the types of paralyzed patient.

Types of paralysis	Average EGM signal (out of 5 voltage)
Complete Paralysis	0.05-0.12
Incomplete or Partial Paralysis	0.10-0.43
Localized Paralysis	0.40-1.56

Table 1 shows the average EMG signal based on the types of paralysis. EMG sensor gives results based on given 5 Voltage. As higher the voltage is, the condition

of the muscle status is better. Voltage varies because of condition of the muscle and age.

Table2: Comparison between Electromyography muscle signal of Localized Paralysis Patient and Normal Muscle condition.

Age	Paralyzed Patient EGM Signal (voltage)	Normal People Maximum EGM signal (voltage)
31-40	1.12-1.56	4.88
41-50	1.02-1.33	4.81
51-60	0.97-0.87	4.34
61-70	0.90-0.43	4.31
71-80	0.85-0.40	4.23

Table 2 compares the voltage of the EMG signal of locally paralyzed patient and Normal Muscle condition(maximum) by the different age group. All the data is collected based on given 5 voltages.

Table 3: Monitoring paralyzed patients of the different stage of recovering stroke.

State of Stroke recovery	EMG Signal (out of 5 voltage)
Flaccidity	0.06-0.70
Dealing with appearance of Spasticity	0.1-0.9
Increased Spasticity	0.83-1.29
Decrease Spasticity	1.2-1.78
Complex Movement Combination	2.03-3.31
Spasticity Despair	3.26-3.97
Normal Function Return	3.90-4.83

Table 3 shows the EMG voltage of different stages of stroke recovery, In this study, these data is collected by monitoring 3 paralysis patient from flaccidity, 2 paralysis patient from the stage of Dealing with appearance of Spasticity, 4 paralysis patient from Increased Spasticity, 3 patient from the stage of Decrease Spasticity, 2 patient from the stage of Complex Movement Combination, 7 people at the stage of Spasticity Despair and 9 people from the stage of normal function return. The recovery stage is defined based on the report of the physiotherapy.

Discussion

Paralysis is the common physical emergency and the most common type of complication is locally paralysis. There is currently no cure to paralysis; however, there are multiple options available in terms of extensive care and mobility that could improve the lives of patients with partial paralysis.[8] For finding the condition of the state of the muscle EMG based analysis is one of the latest technologies. This research aimed to detect the muscle condition of paralyzed patient. Other than that, there are a lot of other applications of SEMG particularly for human-computer interface. As long as there is SEMG data, it could be utilized in any way. Just to list a few possible applications, SEMG could be implemented in control of robotic arm that is used for industrial purpose, to characterize hand gesture recognition[9] which might be useful in sign language, design a wheelchair based on SEMG signal[10] or develop an emotion recognition system.[11] Recently there is a project by students from University Malaysia Perlis on detecting SEMG signal of drowsiness for developing a system to alert drivers.[12]

In the present research, a sample size consisting of 50 adults, both men and women, was analyzed on the basis of their paralyzed muscle condition. Among the analyzed patient in the current study, male was more (75%) and female was (25%), majority of the analyzed patient were 51-60 years old aged group. In this study, we have analyzed different paralyzed patient of different age like, 5 paralyzed patients at the age of 31-40, 11 paralyzed patients at the age of 41-50; 19 patients at the age of 51-60, 9 paralyzed patients at the age of 61-70 and 9 paralyzed patients at the age of 71-80.

This research shows the average EMG signal based on the types of paralysis. EMG sensor gives results based on given 5 Voltage. As higher the voltage is, the condition of the muscle status is better. Voltage varies because of condition of the muscle and age. This research was considered about three kinds of paralysis like Complete Paralysis, Incomplete or Partial Paralysis and Localized Paralysis. The EMG method shows the voltage about 0.05-0.12 at the state of complete paralyzed of triceps muscle, at the state of incomplete or partial paralyzed muscle voltage was 0.10-0.43 and the locally paralyzed hand muscle voltage was 0.40-1.56 voltage. By this method the research also compares the voltage of the EMG signal of locally paralyzed patient and Normal Muscle condition(maximum) by the different age group. All the data is collected based on given 5 voltages. On the scale of given 5 voltages at the age of 31-40, the average voltage was 4.88 of healthy muscle compared to locally paralyzed muscle voltage was 1.12-1.56. At the age of 41-50 the healthy muscle average voltage was 4.81 compared to locally paralyzed muscle voltage was 1.02-1.33. At the age of 51-60 the healthy muscle average voltage was 4.34 compared to locally paralyzed muscle voltage was 1.02-1.33. At the age of 61-70 the healthy muscle average voltage was 4.31 compared to locally paralyzed muscle voltage was 0.90-0.43. At the age of 71-80 the healthy muscle average voltage was 4.23 compared to locally paralyzed muscle voltage was 0.85-0.40.

In this research, analysis also shows the EMG voltage of different stages of stroke recovery. Those data were collected by monitoring 3 paralysis patient from flaccidity which average voltage was 0.06-0.70, 2 paralysis patient

from the stage of Dealing with appearance of Spasticity which average voltage was 0.1-0.9, 4 paralysis patient from Increased Spasticity which average voltage was 0.83-1.29, 3 patient from the stage of Decrease Spasticity which average voltage was 1.2-1.78, 2 patient from the stage of Complex Movement Combination which average voltage was 2.03-3.31, 7 people at the stage of Spasticity Disappear which average voltage was 3.26-3.97 and 9 people from the stage of normal function return which average voltage was 3.90-4.83. The recovery stage is defined based on the report of the physiotherapy.

Conclusion

EMG constitutes a safe and reliable tool for evaluation of management muscle conductivity of paralyzed patients. Our finding suggests maximum signal had received from localized paralysis and muscle of normal condition received more EMG signal. Paralyzed patients have poor muscle conductivity than normal muscle condition. Moreover, there was improved muscle conductivity after recovery from stroke.

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