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Using Electrical Stimulation in Diabetic Therapy

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Abstract
This study aimed to find a new technique for diabetic therapy using new device of electrical stimulation by treating 320 cases of diabetic patient divided in four groups. The first was for patients with no drug and herbal therapy. The second group took 1 tablet of (G or D) or 1herbal dose. The third took more than tablet of (G or D) or (1 tablet + 1 herbal dose). The fourth group was treated by Insulin. All these groups of patients were exposed to electrical stimulation using the above device, and the test of all patients were done, observing that the exposure time increased with the increasing of age for the patient group of the same diabetic level, and the number of patients increases in the range (35-55) year for the first group, (35-60) year for the second group, (30-40) year for the third group. By fitting the curve response we get the mathematic equation that helps us to determine the start point of therapy.

Keywords: Electrical, Diabetic, Stimulation, Therapy.

1. Introduction

Transcutaneous electrical nerve stimulation (TENS) is the use of electric current produced by a device to stimulate the nerves for therapeutic purposes [1]. The unit is usually connected to the skin using two or more electrodes [2]. A significant number of TENS machine brands have been targeted for use for labor pain, although a 1997 report of a study done by the University of Oxford said that TENS "has been shown not to be effective in postoperative and labor pain."[3] Use is documented in the attached references: in obstetric care, particularly in labor; [4] stimulation for pain control was used in ancient Rome, 63 A.D. It was reported by Scribonius Largus that pain was relieved by standing on an electrical fish at the seashore [5]. In the 16th through the 18th century various electrostatic devices were used for headache and other pains. Benjamin Franklin was a proponent of this method for pain relief. In the nineteenth century a device called the electret, along with numerous other devices were used for pain control and cancer cures. Only the electret survived into the twentieth century, but was not portable, and had limited control of the stimulus.In 1855 Guillaume Duchenne, the developer of electrotherapy, announced that alternating was superior to direct current for electrotherapeutic triggering of muscle contractions [6]. What he called the 'warming affect' of direct currents irritated the skin, since, at voltage strengths needed for muscle contractions, they cause the skin to blister (at the anode) and pit (at the cathode). Furthermore, with DC each contraction required the current to be stopped and restarted. Moreover alternating current could produce strong muscle contractions regardless of the condition of the muscle, whereas DC-induced contractions were strong if the muscle was strong and weak if the muscle was weak. Since that time almost all rehabilitation involving muscle contraction has been done with a symmetrical rectangular biphasic waveform. During the 1940s, however, the U.S. War Department, investigating the application of electrical stimulation not just to retard and prevent atrophy but to restore muscle mass and strength, employed what was termed galvanic exercise on the atrophied hands of patients who had an ulnar nerve lesion from surgery upon a wound [7]. These Galvanic exercises employed a monophasic wave form, direct current.In the field of cancer treatment, DC electrotherapy showed promise as early as 1959, when a study published in the journal Science reported total destruction of tumor in 60% of subjects, which was very noteworthy for an initial study [8]. In 1985, the journal CANCER RESEARCH published the most remarkable such study, reporting 98% shrinkage of tumor in animal subjects on being treated with DC electrotherapy for only 5 hours over 5 days [9]. The mechanism for the effectiveness of DC electrotherapy in treating cancer was suggested in an article published in 1997 [10]. The free-radical (unpaired electron) containing active-site of enzyme Rib Nucleotide Reductase, RNR-which controls the rate-limiting step in the synthesis of DNA—can be disabled by a stream of passing electrons.

2. Experimental

The patients were exposed to Electrical Stimulation using local and safe medical Electrical Stimulation apparatus with voltage less than 75 volts and low current, which a certificate from Ministry of Science and Technology (Figure 1). 320 diabetic patients were divided in four groups. The first was for patients with no drug and herbal therapy. The second group took 1 tablet of Glucophage (G) or Daonil (D) or 1herbal dose. The third took more than tablet of (G or D) or (1 tablet + 1 herbal dose). The fourth group was treated by Insulin. In the same group patients were distributed according to their ages and blood sugar level. The electrical stimulation exposure time needed for every patient (according to their diabetic tests to decrease the blood sugar level) was recorded to plot the relation between the exposure time and the blood sugar level.

Figure 1: Local and Safe Medical Electrical Stimulation Apparatus.

3. Result and Discussion

Electrical Stimulation is a new technique in therapy summarized by supplying living cells with electricity that rise their activity, and this includes the Pancreas cells that gives many indicators like deep yellow urine with bad smell and decreasing in blood sugar level for diabetic patients to less than (100 µg / ml) with the increasing of the Electrical Stimulation exposure time range. Figures (2- 5) show the relation between the Electrical Stimulation exposure time and the blood sugar level for the first group of diabetic patients of different age ranges (30 – 35 years age), (35 – 40 years age), (40 – 45 years age), and (45 – 50 years age) respectively. Figures (6 - 9) show the relation between the Electrical Stimulation exposure time and the blood sugar level for the second group of diabetic patients of different age ranges (40 – 45 years age), (45 – 50 years age), (50 – 55 years age), and (55 – 60 years age) respectively. Figures (10 - 12) show the relation between the Electrical Stimulation exposure time and the blood sugar level for the third group of diabetic patients of different age ranges (35 – 40 years age), (40 – 45 years age), and (45 – 50 years age) respectively. Finally Figures (13- 15) represent response curves of the fourth group of diabetic patients that take Insulin only, of different age ranges (less than 10 years age), (20 – 25 years age), and (25 – 30 years age) respectively. (Table 1) represent the coefficients of fitting for curves of response for every patients group, if the patient gets his special program for nutrition and sport.

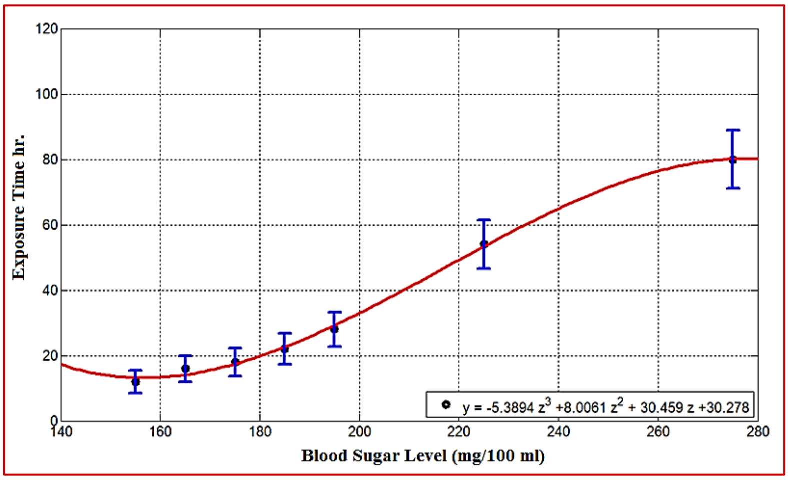

Figure 2: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the first group of diabetic patients (30 – 35 years age).

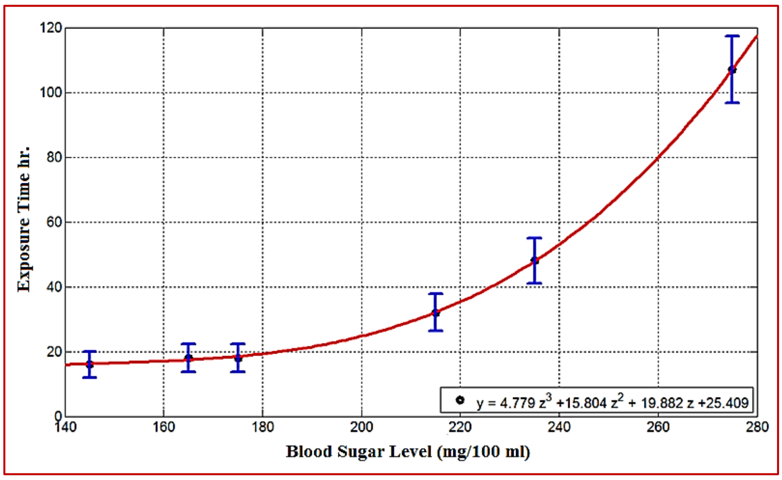

Figure 3: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the first group of diabetic patients (35 – 40 years age).

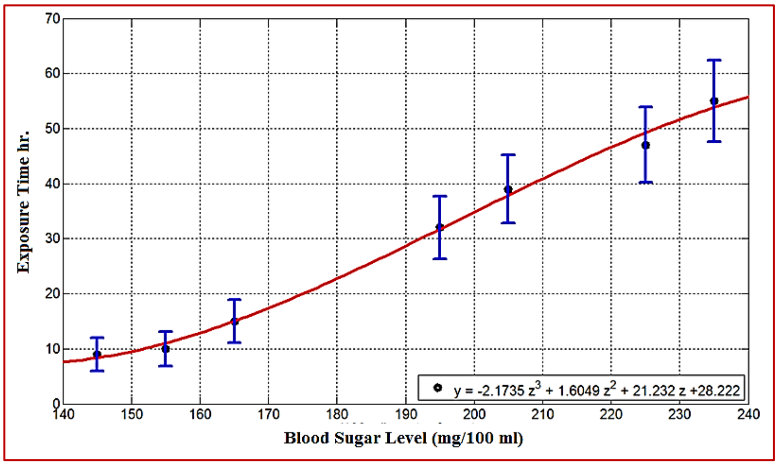

Figure 4: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the first group of diabetic patients (40 – 45 years age).

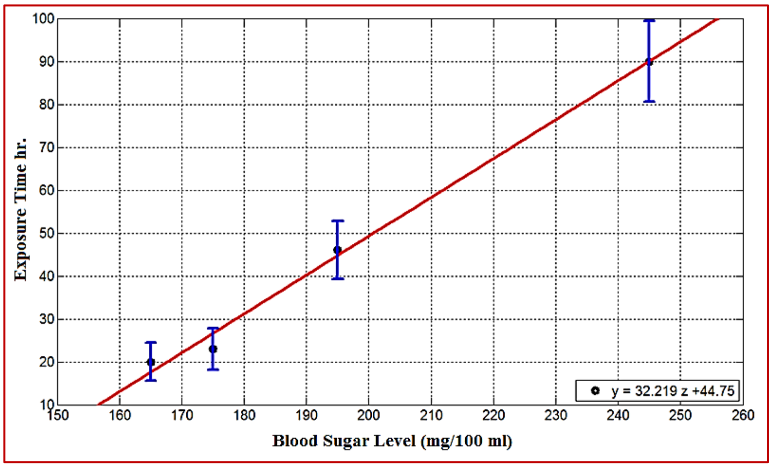

Figure 5: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the first group of diabetic patients (45 – 50 years age).

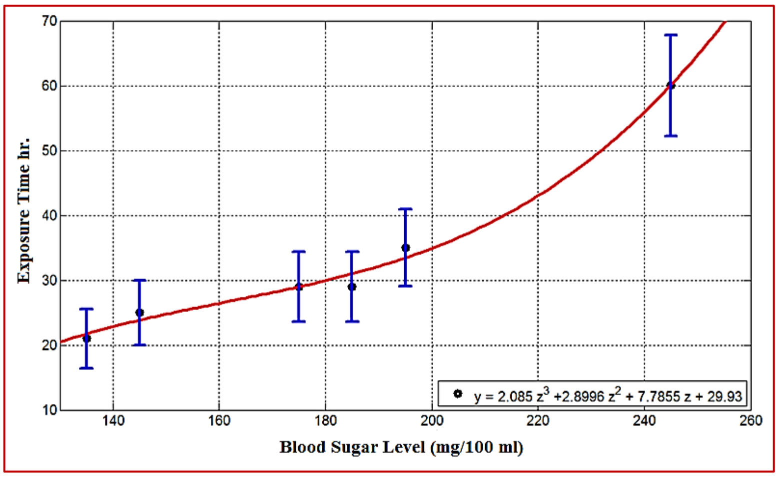

Figure 6: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the second group of diabetic patients (40 – 45 years age).

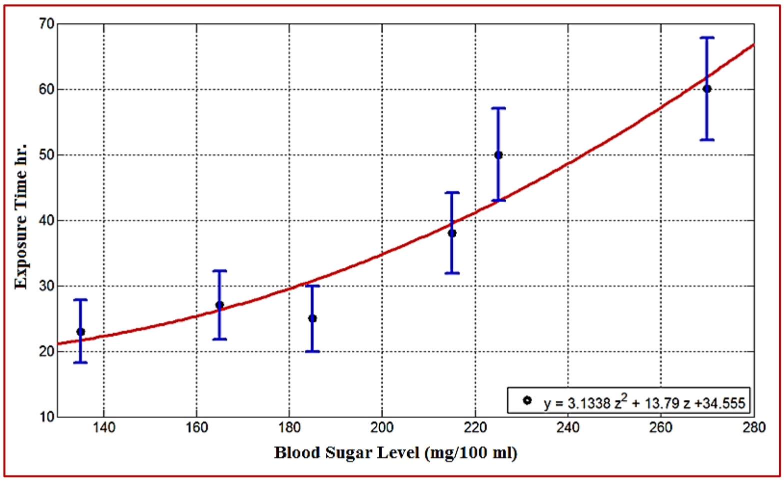

Figure 7: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the second group of diabetic patients (45 – 50 years age).

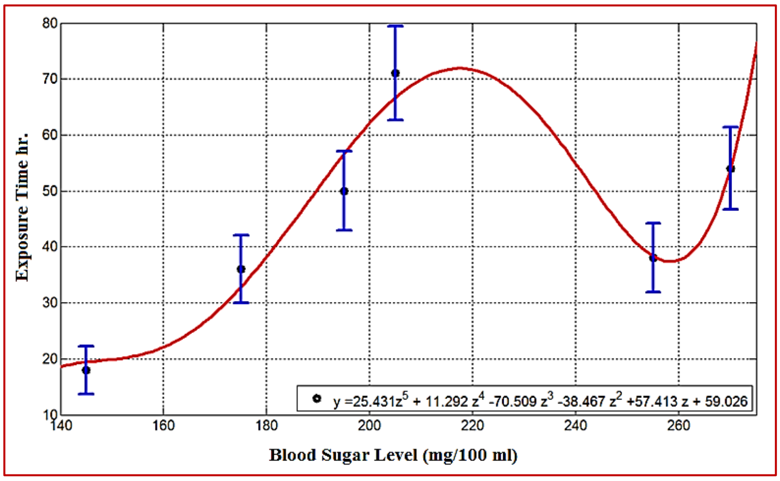

Figure 8: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the second group of diabetic patients (50 – 55 years age).

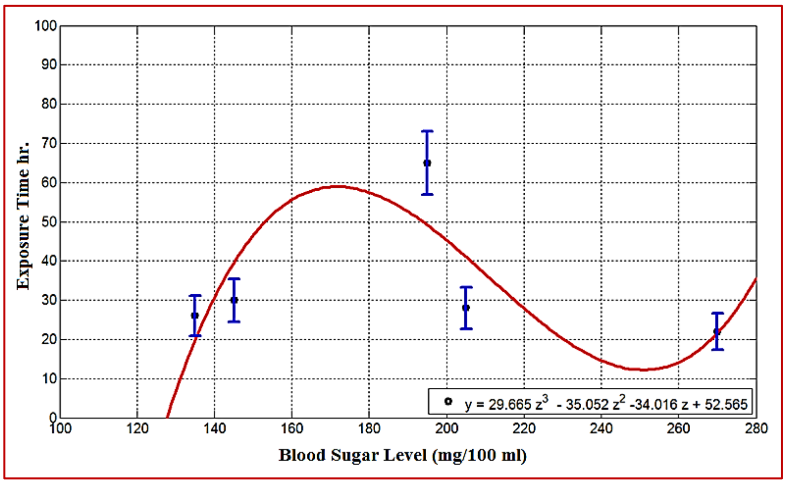

Figure 9: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the second group of diabetic patients (55 – 60 years age).

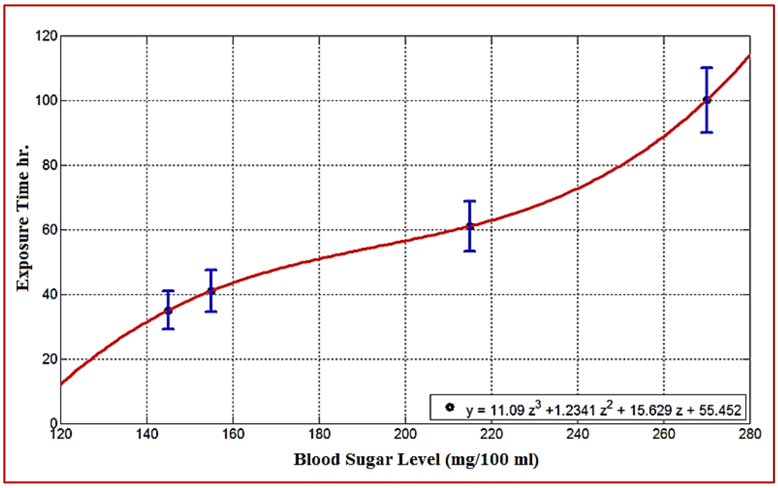

Figure 10: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the third group of diabetic patients (35 – 40 years age).

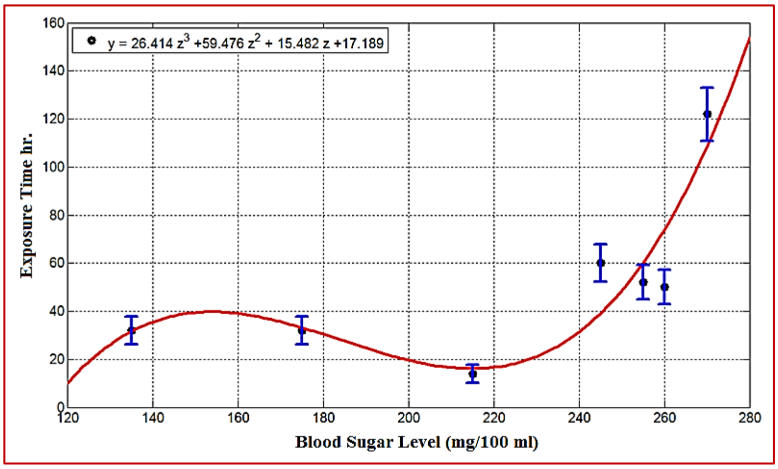

Figure 11: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the third group of diabetic patients (40 – 45 years age).

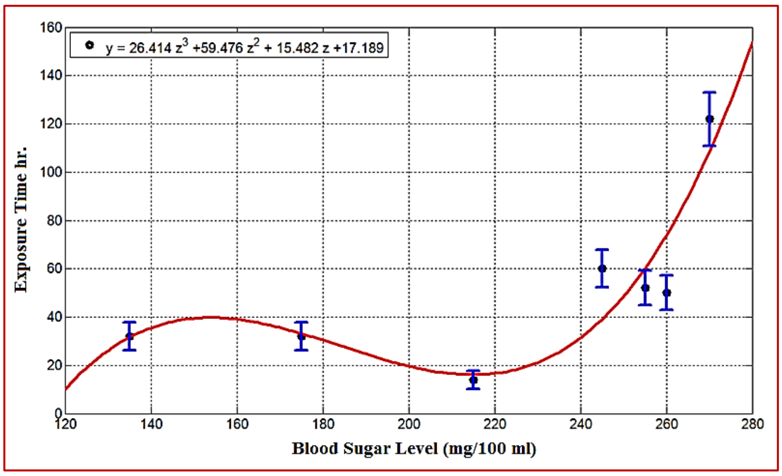

Figure 12: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the third group of diabetic patients (45 – 50 years age).

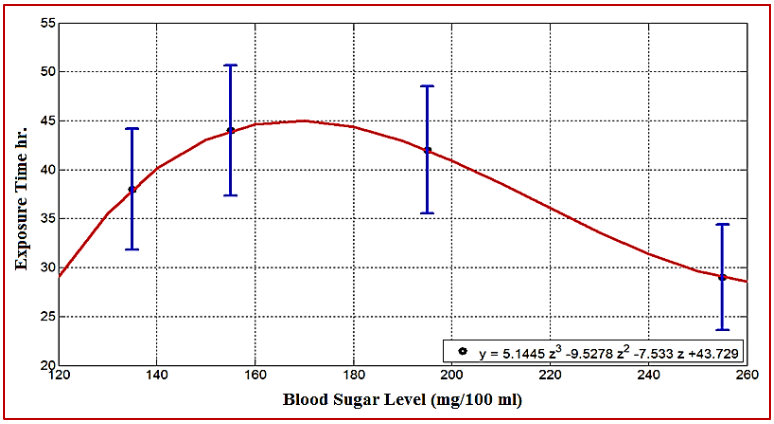

Figure 13: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the fourth group of diabetic patients (less than 10 years age).

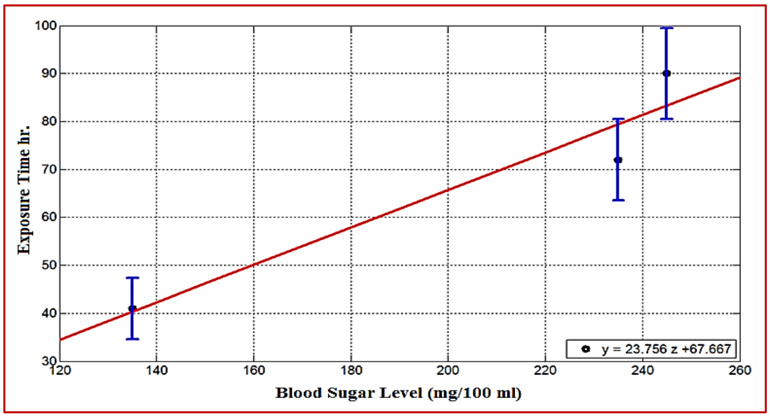

Figure 14: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the fourth group of diabetic patients (20 – 25 years age).

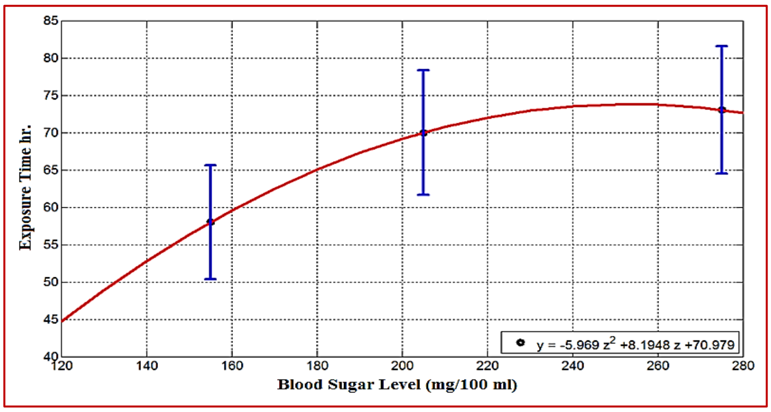

Figure 15: Relation between the Electrical Stimulation Exposure Time and the Blood Sugar Level for the fourth group of diabetic patients (25 – 30 years age).

Table 1: Fitting Coefficients for curves of response.

Patient group	Age range years	P1	P2	P3	P4
First	30 – 35	-7.953 x 10^{-5}	0.04941	-9.888	641.5
	35 - 40	- 4.099 x 10^{-5}	-0.01818	2.737	0.0
	40 - 45	-5.047 x 10^{-5}	0.02997	-5. 314	320.7
	45 - 50	0.0004024	0.2436	-47.63	3054
Second	40 – 45	-3.417 x 10^{-5}	-0.01658	2.845	-144.3
	45 - 50	-3.867 x 10^{-5}	0.02488	-4.876	323.9
	50 - 55	-6.326 x10^{-8}	-6.132 x10^{-5}	0.02327	-4.322; P5 = 393.8; P6 = 1409 x 10^{4}
	55 - 60	0.000187	-0.01192	24.37	-1559
Third	35 - 40	0.002162	-0.04218	52.73	0.0
	40 - 45	0.002622	-0.4789	43.75	0.0
	45 - 50	0.0001439	-.0.07985	14.42	-814.7
Fourth	Less than 10	-3.472	-0.02267	4.682	-266.2
	20 - 25	0.01355	-4.702	428.9	0.0
	25 - 30	- 0.001643	0.8314	-31.4	0.0

4. Conclusion

Most of the plotted curves show nonlinear increasing in Electrical Stimulation exposure time except some points which don't obey this rule because of many reasons like gender type, weight, and history of patient with disease. From the curves fitting we get mathematic equations that help us in determining the start point for monitoring the response of the patient to avoid the suddenly decreasing in blood sugar level, the needed exposure time of the Electrical Stimulation for each patients group and the start point for decreasing his drugs with time, which effected to get therapy for diabetes from the generalized formula that we get.

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