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"Emedica: A Noninvasive Device to Improve Insulin Sensitivity in Type 2 Diabetes Patients".

Hemant Rohera[1*], Dr Ramesh Chouhan[2], Dr. Mrunali Jambhulkar[3], Dr. Vaishali Khatri[4], Dr. Deepak Nagpal[5]

[1*]Director, Research and development, Rohera Healthcare Technologies, Pune, Maharashtra, India
[2]Vice President and Dean of World Academy of Medical Sciences Netherland
[3]Senior Lecturer, Department of Oral Pathology and Microbiology, Swargiya Dadasaheb Kamlesh Smruti Dental College and Hospital.
[4]Professor of Physiology, AUC-UK Track, School of Medicine and Dentistry, University of Central Lancashire, Preston, UK.
[5]Ex-Dean, Professor and Head, Department of Oral Pathology and Microbiology Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

Abstract:
Insulin resistance is a key factor in the pathogenesis of type 2 diabetes mellitus (T2DM). This study is aimed to evaluate the effect of eMedica, a noninvasive device working on frequency-modulated electrical current therapy, in fat reduction and improved insulin sensitivity in type 2 diabetic patients. A cross-sectional study design was employed to evaluate alterations in insulin resistance, heart health, and the functioning of cells through statistical analysis in cohort of 25 patients with T2DM. The dataset provided insights into the glucose levels and insulin measurements of participants. The mean blood sugar level before and after intervention with eMedica therapy is 151.14 mg/dl, dropping significantly to 58.30 mg/Dl after therapy by e-Medica. These findings can help tailor diabetes management strategies and contribute to further analysis of participants' health profiles and treatment responses. This drop in the blood sugar levels after using eMedica therapy is prominent finding which can be used in routine management of the patients.

Introduction:
A significant contributor to the onset of type 2 diabetes is insulin resistance. Fat accumulation in and around cells (intracellular and pericellular fat) impairs insulin signaling pathways, leading to reduced insulin sensitivity. Insulin is a chemical released by β cells in the islets of Langerhans, which regulates the breakdown of carbohydrates, proteins, and fats by encouraging the uptake of substances such as glucose from the bloodstream into fat cells, skeletal muscle cells, and the liver [1-2]. Many different physiological irregularities are linked to type 2 diabetes mellitus (T2DM). It's well-known that a reduction in the ability of peripheral tissues, especially muscles, to take up glucose, along with an increase in the body's own production of glucose, are key characteristics of insulin resistance. Higher levels of lipolysis, increased free fatty acid concentrations, and the buildup of certain lipid by-products all lead to more glucose being released, less glucose being used by peripheral tissues, and damage to the function of beta cells. Resistance of fat cells to insulin and inflammation are recognized as significant factors in the onset of type 2 diabetes mellitus. A decrease in the activity of insulin, especially through the insulin receptor substrate (IRS)/phosphoinositide-3-kinase (PI-3K)/protein kinase B (PKB) pathway, leads to insulin resistance, which can impact how insulin works in the body [2]. Insulin resistance is often associated with obesity, which is a key factor in the development of type 2 diabetes mellitus (T2DM) [3, 4]. The metabolic effects of insulin resistance can lead to conditions such as hyperglycemia, hypertension, dyslipidemia, hyperuricemia, heightened inflammatory markers, endothelial dysfunction, and a prothrombotic state. The most significant consequence of insulin resistance is the development of type 2 diabetes (T2D), which is believed to occur 10 to15 years after the onset of insulin resistance. For the management of insulin resistance the centre for disease control has proposed the following strategies:

Reverse insulin resistance
By
1. physical activity which makes us more sensitive to insulin, one reason it's important for diabetes management.
2. Weight loss if overweight or obesity it is another great way to relieve strain on your body and increase your insulin sensitivity.
3. Eating a balanced diet with non-starchy vegetables, fruits, whole grains and lean proteins helps to reduce blood sugar. This will decrease the amount of insulin pancreas releases to help reverse insulin resistance.
4. Other lifestyle changes like managing stress, and getting enough sleep.

Furthermore, medications can be utilized to improve insulin response and decrease insulin demand. The majority of complications linked to insulin resistance are related to vascular complications and nonalcoholic fatty liver disease [3-5]. The need to develop non-invasive interventional approach in the current hectic lifestyle with increasing stress is the need of the hour. Using frequency-modulated electrical current therapy that may have significant effects insulin resistance,

cardiovascular health, and cancer prevention can be a very useful tool in managing in the routine medical healthcare. We developed an innovative tool eMedica a non-invasive device working on frequency-modulated electrical current therapy. This device needs to be wearied through appropriate bands designed around the palms (Figure 1 and 2). Based on the requirement the timings of the application can be adjusted in routine, we have used 30minutes to 60 minutes in a day. This study is thus aimed to evaluate the effect of eMedica in fat reduction and improved insulin sensitivity.

Methodology:
Given the medical and health-related focus of this research, a study design that combines cross-sectional and intervention aspects was crucial for accurately evaluating alterations in insulin resistance, heart health, and the functioning of cells through statistical analysis. This approach was employed to ascertain if the eMedica device had a significant effect on the health indicators being measured in the 25 patients who came to our specific clinic to participate in the trial, who chose to do so on their own willingness. The patients were fully informed about their participation in the study, including all the potential advantages and risks involved, before they were enrolled. The study was approved by the institutional ethical review board at Apollo Hospital Pune before it began. The privacy of the patients was carefully considered, and their information was protected using a randomized allocation system for codes.

Result:
The dataset provides insights into the glucose levels and insulin measurements of participants, with ages ranging from 26 to 61 years. It offers potential insights into the effectiveness of interventions and variability in metabolic responses among participants.

Correlation Results:
- Pre-Measurement: A moderate positive relationship (0.40) exists between age and blood sugar levels before meals (Figure 3).
- Post-Measurement: A weaker positive relationship (0.27) is found between age and blood sugar levels after meals.
- After 2hrs Measurement: A very weak positive relationship (0.15) is observed between age and blood sugar levels two hours after meals.

Intervention by eMedica Analysis:
- Mean Blood Sugar Levels: Before eMedica intervention, the mean blood sugar level is 151.14 mg/dl, dropping significantly to 58.30 mg/dl after therapy by eMedica (Figure 4).
- Standard Deviation: The standard deviation decreases from 91.15 to 78.35, suggesting reduced variability.
- T-Statistic and P-Value: The p-value (4.08e-05) is much lower than the typical significance level of 0.05, indicating a statistically significant difference in blood sugar levels before and after eMedica therapy.

Insulin Distribution:
- Mean: The average insulin level is 21.368.
- Median: The middle value in the dataset is 18.0.
- Standard Deviation: The spread of the insulin levels is 11.16.
- Minimum: The lowest insulin level recorded is 5.4.
- Maximum: The highest insulin level recorded is 55.0.

Blood Sugar Trends:
- Average blood sugar levels increase with age, from 132.5 in the 20-29 age group to 202.0 in the 60-69 age group.

Clusters of Participants:
- Three clusters are identified based on blood sugar levels and insulin measurements.
- Participants are grouped into distinct clusters with varying blood sugar and insulin levels.
- Cluster 0 has lower blood sugar and insulin levels, while Cluster 2 shows higher values.
These findings can help tailor diabetes management strategies and contribute to further analysis of participants' health profiles and treatment responses.

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Figure 1: the eMedica Device

Figure 2: patients using the eMedica Device

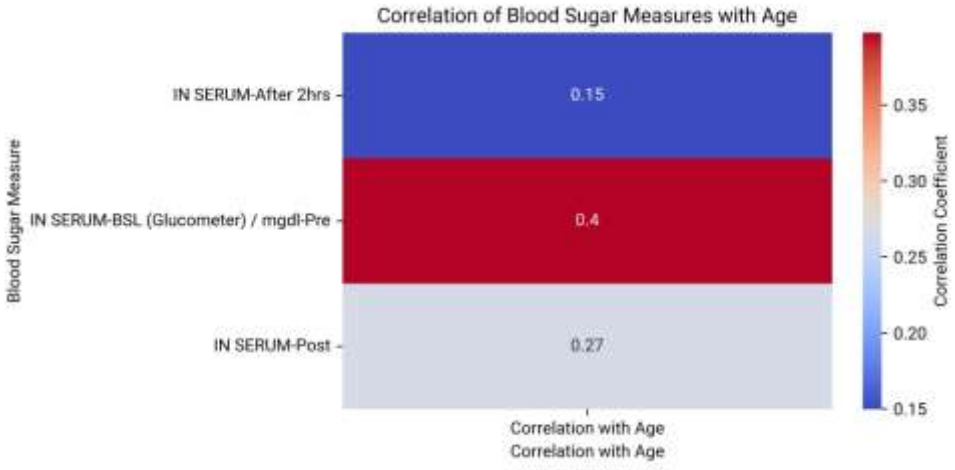

Figure 3: positive relationship (0.40) exists between age and blood sugar levels before meals

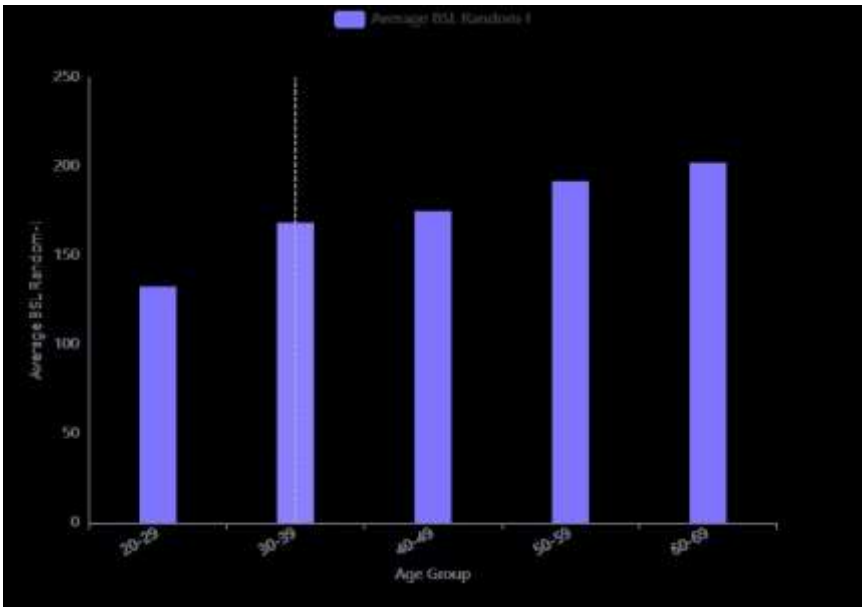

Figure 4: Average blood sugar levels of the participant

Discussion:

The adverse effects associated with pharmaceuticals in disease prevention have consistently garnered academic interest. Consequently, early intervention strategies for diabetes primarily emphasize exercise and dietary modifications. Given the minimal side effects and high safety profile of natural medicines, it has been proposed that these remedies could be instrumental in disease prevention and may serve as valuable complements to preventive measures like physical activity [6].

Insulin resistance is a key factor in the pathogenesis of type 2 diabetes. Fat accumulation in and around cells (intracellular and pericellular fat) impairs insulin signaling pathways, leading to reduced insulin sensitivity [7]. The eMedica device uses electrical current to target fat deposits, aiding in their breakdown and removal. This reduction in cellular fat enhances insulin receptor function, allowing for better glucose uptake, whether insulin is produced naturally or administered exogenously. The frequencies emitted by the eMedica device target specific cellular processes, potentially improving organ function. By restoring the electrical balance within cells, the device supports cellular repair and regeneration. As a result, the overall function of organs is enhanced, leading to better systemic health [8-10]. The combination of voltage infusion and current application builds the electrical parameters necessary for optimal cellular metabolism. Improved electrical activity at the cellular level supports the efficient use of energy, increases mitochondrial function, and promotes overall cell health. By burning fat and enhancing energy production, the device contributes to better metabolic health and fat loss. In the current study we found a positive correlation in serum sugar levels before and after intervention with eMedica therapy where the mean blood sugar level is 151.14 mg/dl, dropping significantly to 58.30 mg/dl after therapy by eMedica. This drop in the blood sugar levels after use of eMedica therapy is prominent finding which can be used in routine management of the type 2 diabetic patients. In a review by Peishan Wu listed some cytokines and genes that have recently been found to play roles in mitochondrial stress and insulin resistance. He also describes several natural drugs that are currently widely used and give a brief overview of their therapeutic mechanisms [6].

In a study by Irena Krusche-Mandl showed that use of low frequency modulated electric current therapy in pain management of patients with knee osteoarthritis to be beneficial to reduce knee pain and improve knee function [7]. In our previous published studies we have found improvement in sugar management, hypertension and COVID 19 infection using eMedica therapy [8-10]. In our present study we found the improvement of insulin levels in type 2 diabetic patients using eMedica therapy.

We could also find the trend of increase in blood sugar levels with increase in the age and the primary cause being decrease to insulin sensitivity. The eMedica device uses electrical current to target fat deposits, aiding in their breakdown and removal. This reduction in cellular fat enhances insulin receptor function, allowing for better glucose uptake, whether insulin is produced naturally or administered exogenously.

Conclusion: The adverse effects of pharmaceuticals in disease prevention have led to interest in natural remedies and early intervention strategies like exercise and dietary modifications for diabetes management. The use of the eMedica device, utilizing electrical current to target fat deposits, has shown promising results in improving insulin sensitivity and overall metabolic health in type 2 diabetic patients.

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