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Effect of MRI on Blood Glucose Level of Patients

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Abstract

Background & Objective: There are reports of the effect of magnetic fields on blood glucose level. But no final agreement has yet been reached on whether to reject or accept these reports. The objective of this study is to evaluate the effect of MRI with magnetic strength of 0.35 Tesla on blood glucose level in patients.
Materials & Methods: This is an analytical study performed at Gonabad MRI Center; 100 patients referred to MRI center were selected by convenient sampling method. Blood glucose was determined before and after entering the imaging room by a glucometer. Data analysis was performed using SPSS software version 14.5 using Wilcoxon test (P-value<0.05).
Results: The results showed that the mean blood glucose level of patients referred to the MRI center was 112.15 ± 20.39 before MRI and 104.03 ± 15.97 mg/dl after MRI (p<0.001), which showed a significant decrease in blood glucose level.
Conclusion: The findings show that MRI with a magnetic field strength of 0.35 Tesla can lower blood glucose level. Therefore, it is recommended to measure this level in people who should not have hypoglycemia before MRI.
Keywords: MRI, blood glucose, magnetic field

Introduction

Magnetic Resonance Imaging (M.R.I) is a medical imaging technology, the first version of which was introduced to the clinical field in 1978 and has been continuously evolving ever since (1).

MRI is one of the medical imaging techniques that provides very good quality images of anatomical structures of the human body and is widely used today for diagnostic applications.MRI is the technique of choice for high-detail detection of soft tissue properties (2). The most important advantage of MRI is that it is non-invasive, because this technique uses the magnetic properties of hydrogen and its interaction with a strong magnetic field and radio waves to produce images (3). Currently, M.R.I devices typically use magnetic fields in the

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strengthrange of 0.2 to 3 Tesla, whereby all or part of the patient's body is exposed to this magnetic field.There is disagreement about vital effects of magnetic fields (4).

Researchers have been studying the potential for vital effects of magnetic fields for more than four decades, but due to the lack of good evidence and proper design of experiments, including the complete elimination of confounders, many of these studies have not been accepted by other researchers. However, reliable findings are available on the effect of magnetic fields on enzyme activity, cell growth and proliferation and resistance of bacteria, glands and metabolism, neural perception and cognition and conduction, blood and neoplasm (5,18).The reaction changes of living systems that are exposed to magnetic fields of different strengths or at different time periods are of interest to molecular biologists, chemists, and physicists.Currently the use of magnetic field has become an advanced technology in Australia, USA, China and Japan (6).

The results of studies on the effects of electromagnetic waves indicate that changes in field strength, even by a few milliteslas, have different biological effects.Therefore, research on electromagnetic waves can be done in a wide range (7).Studies have shown that electromagnetic fields induce a variety of responses in living organisms by altering the function or functional stages of cells, including the effect on cell proliferation and differentiation and changes in enzymatic activity ofantioxidants (8).

Glucose is the most important and abundant blood sugar. This is important because some of the body's most vital organs, such as the brain, feed exclusively on this substance, and its presence is essential for metabolism of other substances, such as fats.Blood glucose comes from sugars and starches. Meanwhile, some organs, such as the liver and kidneys, are able to make glucose from other foods, such as amino acids, when people are hungry (9).

One study in mice reported hypoglycaemia and another reported no significant change in blood sugar after exposure to magnetic fields (10-11).Studies on humans also show contradictory results in this regard (12-13).Due to the necessity of maintaining blood glucose concentration and the contradictory results reported, this study was performed to determine the effect of MRI on blood glucose level of patients referred to the MRI center.

Materials and Methods

This analytical study was performed in the MRI center of 22 Bahman Hospital in Gonabad. To determine the sample size, a pilot study was performed on blood glucose variable. Based on the

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formula for comparing the mean of two dependent populations and considering the confidenceinterval of 0.95 and test power of 80%, the sample size was calculated; finally, n=100 was considered for the study considering 10% sample loss.

Samples were selected from patients admitted to the hospital for non-contrast MRI by non-probability convenient method.Inclusion criteria were: consent to participate in the study, MRI time of ten to thirty minutes, age between 20-60 years, no pregnancy, no known mental disorders and severe anxiety, no history of underlying disease (16,17). Exclusion criteria included: lack of consent to continue participating in the study and interruption of MRI imaging for any reason.

After the project was approved by the Research Ethics Committee of Gonabad University of Medical Sciences (Code CER.UMG.1393.90), eligible patients referred to the MRI Center were selected; after explaining the objectives of the study and obtaining written consent, blood glucose was determined before and after entering the imaging room.Patients were present in the center for at least 15 minutes in the temperature range of 25-30°C and relative humidity of 40-50% (14).In all patients, lancet was tapped on outside of the middle finger of the left hand.A MRI machine (Newsoft, China) available in 22 Bahman Hospital in Gonabad with a magnetic field strength of 0.35 Tesla was used and Glucometer GL-40 Beurer Germany was used in all patients.

Data was collected using SPSS software version 14.5 and analyzed at a significance level of less than 0.05.For quantitative variables, mean and standard deviation were used, and for qualitative variables, absolute and relative frequency were used. The Kolmogorov-Smirnov test was used to determine normality of blood glucose level. As data was not normal, Wilcoxon test was used to compare the mean blood glucose levels before and after MRI.

Results

One hundred people participated in this study, of whom 50% were women and 50% were men, 31% were employees, 39% were housewives, 4% were students and 26% were self-employed. Demographic characteristics of the samples are given in Table 1. MRI site was 56% in the spine, 17% in the head, 15% in the knee and 12% in other parts. The mean duration of MRI was 17.55 ± 6.75 minutes.

There was a significant difference in blood glucose level before and after MRI ($p<0.001$), so that blood glucose of the subjects decreased after MRI compared to before (Table 2).

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Discussion

In the present study, blood glucose of patients was evaluated and compared before and after MRI. The results showed that MRI with a magnetic field of 0.35 Tesla can lower blood glucose.The results of Eghdami et al showed that a magnetic field with a frequency of 15 Hz and astrengthof 150 microtesla reduces blood glucose in mice, which is consistent with the findings of this study (10).The results of Groczynska and Wegrzynowicz show that blood glucose of mice after 10 days of exposure to magnetic fields with inductions of 10 and 100 Gauss is similar to mice that have never been in the field (11), which is not consistent with the results of this study.Abbasi et al. also showed that a constant electromagnetic field with a strengthof 50 microteslahad no effect on weight gain and blood glucose in mice (12), which is not consistent with the findings of this study.The strength of the magnetic field used in the above three studies is lower than the present study. In the present study, the magnetic field used was 0.35 Tesla.

Harakawa et al. also showed that a 50 Hz electromagnetic field increases glucose (13), which is not consistent with the findings of this study.The results of Zareet al. also showed that electromagnetic fields with frequencies of 5 and 50 Hz and field strengths of 0.013 and 0.207 microtesla for 2 to 4 hours reduce blood glucose in the 50 Hz magnetic field (15) which is consistent with the findings of this study. The difference in findings may be due to the amount of field strength used as well as the studied subjects.

The decrease in blood glucose may be due to the increased sensitivity of pancreatic beta cells to glucose, due to the increased entry of calcium into these cells and the facilitated entry of glucose into water, which cannot cross the cell lipid membrane without insulin.Magnetic fields may facilitate the entry of glucose into cells by inducing electrical charge in the cell membrane and disrupting the order of the lipid bilayer membrane (14, 10).

Early on, due to creation and expansion of various industries such as electricity, electronics and telecommunications and study of their destructive effects and consequences, studies focused on possible negative aspects of electromagnetic waves (19).But various studies that have shown beneficial effects on living tissues have drawn the attention of researchers to the use of positive effects of fields in medicine.There are reports that using magnetic fields as a kind of physical therapy can reduce human blood glucose.No information is available on characteristics, induction power and duration of magnetic therapy in these studies. Our findings suggest the possibility of hypoglycemia in therapeutic use of magnetic fields.

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Conclusion

MRI with a magnetic field of 0.35 Tesla can lower blood glucose level.Perhaps a magnetic field can be used as a physical therapy to control blood glucose, which requires further research.On the other hand, measuring this index before MRI with magnetic field of 0.35 T is recommended in people who are exposed to severe hypoglycemia.

Table 1: demographic variables of subjects (N=100)

Variable	Mean	SD
Age (y)	38.74	11.73
Weight (kg)	70.84	11.43
Height (cm)	165.11	7.53
BMI (kg/m^2)	25.95	3.59

Table 2: comparison of blood glucose of patients before and after MRI (N=100)

Stage	Mean±SD (mg/dl)	Result
Before MRI	112.15±20.39	Wilcoxon test:
After MRI	104.03±15.97	P<0.001

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