

Effect of Pulsed Magnetic Field on Wound Healing Property in Wistar Rats: A Preliminary Study.

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Abstract: The wound healing properties of Pulsating Magnetic Field (PMF) therapy are well known. The normal healing process manifests in four stages : 1) Debridement, 2) Contraction, 3) Epithelialisation and 4) Remodeling. By exposing the wound to PMF of very low frequency and intensity it was found that the healing process could be accelerated. At our centre a four coil assembly has been fabricated with a function generator which supplied a pulsating electric current of sine wave mode to the coil to treat small animals. Two groups of Wistar rats six in each with artificial wound created on the dorsal area of 1cm diameter, leaving one group to natural healing and the other subjected to daily 30 minutes PMF therapy was given for a period of 15 days. Daily measurement of the wound area was noted in each animal in both groups and rate of healing calculated and responded graphically. It was seen that the experimental group with PMF showed a faster rate though small, than the control group which received no PMF.

Key words: Pulsating Magnetic Field (PMF), wound healing process in animal model.

INTRODUCTION

Magnets are purported to aid wound healing despite a paucity of clear scientific evidence. Although there is ample experimental and clinical evidence supporting the use of magnetic field to aid bone healing, its application for soft tissue healing, including skin and tendons, is still ambiguous. Promising research along these lines was first produced in the 1960s by Becker. Studying amphibians, he described the presence of an electromagnetic skin circuit, alterations which accompanied limb regeneration¹ but still the effects of Pulsed magnetic Field (PMF) on treatment purpose are a promising unearched area of research. The purpose of this study was to evaluate the effect of pulsed magnetic fields produced by a four coil co-axial assembly one parallel to the other placed in east west directions using a given wave form current from a function generator, which produces a pulsing magnetic field of known frequency and amplitude is used for healing in medicine. In the present project this pulsed magnetic field therapy with low frequency and intensity in sine wave form² was used in Wistar rats.

MATERIALS AND METHODS

We used healthy wistar rats weighing 100-150g classified into I and II groups each having six animals. Both the animal groups were shaved on the dorso-trunk area, 1.5 cm from the midline. After anaesthetizing with measured quantity of diethyl ether a circular wound was created on both groups, using a skin biopsy punch to ensure maximum uniformity in the area of the wound 9 see plate1. the animals were given standard feed, water, light and temperature environment during study. The test group animals are exposed to PMF of 1Hz of ±250nT of field strength for duration of 30 minutes every day till 15th day and an additional five days observation of the wound is to be carried out. The areas of the wound in test and control animals were measured using tracing paper-graph sheet planimetry every day till 20th day. The wound area was measured in millimeter square in both groups and recorded and the changes in the rate of wound healing area were noted.

RESULTS

The mean rate of contraction of the wound is compared between the



Plate1: A skin biopsy punch to ensure maximum uniformity in the area of the wound 9 see.

control and test groups noting the percentage of decrease I area from 0 day to 20th day. The rate of healing was calculated as the ratio of decrease in area to the preceding area in a given interval in percentage. The mean area of the wound in each animal group versus time elapsed from wound creation was serially measured (Table I & Figure 2) and this was the indicator for the rate of wound healing. The Table 2 depicts the percentage difference of healing in test and control in three days interval in succession till the 15th day, which indicates a tendency of greater delay in healing (figure 3). Regarding the rate of healing related to the test and control groups, the mean value shows a small difference and ‘P’ value being 0.559, the difference in not statistically significant.

(X axis shows the percentage of healing)

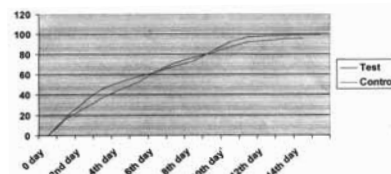


Figure 1: Rate of decrease in area respect to initial area

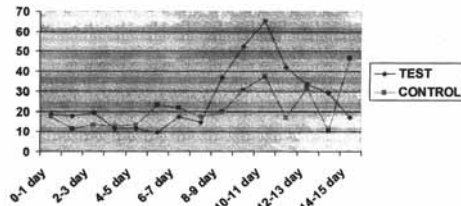
Table 1: Rate of Healing with respect to initial area

Days	Percentage of healing in test group	Percentage of healing in control group	Days	Percentage of healing in test group	Percentage of healing in control group
1	18.9	17.1	9	83.1	81.2
2	33.2	27.2	10	92	87.1
3	46.2	37.1	11	91.1	91.9
4	52.5	45.2	12	98.4	93.3
5	58	52.8	13	98.9	95.4
6	62.2	63.9	14	99.1	95.9
7	68.7	71.7	15	99.1	97.8
8	73.3	76.7			

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Table 2: Percentage difference in Healing

Days	Test	Control	Days	Test	Control
0-3	2.60%	2.36%	9-12	0.86%	0.77%
3-6	0.90%	1.70%	12-15	0.04%	0.28%
6-9	1.19%	1.11%	Mean	1.118	1.244
			S.D.	0.93	0.81

**Fig 3: Rate of decrease in area compared with previous day area**

DISCUSSION

Indirect evidences suggest that PMF therapy could augment peripheral blood flow via reflex vasodilation following epigastric in normal subjects³. However there have been no direct measurements of PMF effect on blood flow at the site of application which ultimately would be a target of potential wound healing interventions⁴. Less consistent results have been reported in investigations of the direct effect of magnetic energy on cutaneous blood flow. Miura and Okada showed that the arterioles of frog's webs dilate on response to pulsed electromagnetic radiation. This effect was shown to be independent of heat and was postulated to involve the modulation of calcium balance in vascular smooth muscle cells⁵.

The wound contracts owing to the vaso-elastic properties. A wound of say five cm diameter can close completely by the contraction property. This depends on the growth of blood vessels and tissue into the contracting margin of the wound. Exposing the wound to PMF of low frequency and intensity quickens the wound healing⁶. The modes of action of PMF said to be

1. Vaso-dilatation by increasing the local blood supply which accelerates the vasodilatation process⁷.
2. Increasing the oxygen supply to the tissues and helpful to control infection as well as increasing the local metabolism⁸.

In the present pilot experiment as indicated graphically in fig IV the test group animals as the wound undergoing PMF throughout is showing although not significant a quicker rate of healing. It can also be noted that from 9th day the healing rate variation of test animals become marked as seen in fig IV.

CONCLUSION

We have found that wounds of animals which had PMF therapy healed faster than those which was left to natural process, which was the control group. Whether PMF could be an effective adjunct in quickening the healing processes of the wound could be reconfirmed by taking more number of animals and subjecting them to bigger wounds instead of 1cm diameter.

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LITERATURE REVIEW

Short-term Outcomes of Induction Therapy With Tacrolimus Versus Cyclophosphamide for Active Lupus Nephritis: A Multicenter Randomized Clinical Trial.

Wei Chen, Xueqing Tang, Qinghua Liu, et al. *American Journal of Kidney Diseases, Volume 57,(2):235-244, 2011*

Intravenous cyclophosphamide with prednisone is an effective treatment for lupus nephritis, but with significant toxicities. We compared the efficacy and safety of tacrolimus versus intravenous cyclophosphamide as induction therapy. Multicenter randomized controlled trial, analysis data on 81 patients with biopsy-proven lupus nephritis from 9 nephrology centers in China from 2006-2008. patients were treated with Prednisone and either tacrolimus (n = 42) or intravenous cyclophosphamide (n = 39) for 6 months. Tacrolimus was started at 0.05 mg/kg/d and titrated to achieve a trough blood concentration of 5-10 ng/mL. Intravenous cyclophosphamide was initiated at 750 mg/m² of body surface area, then adjusted to 500-1,000 mg/m² every 4 weeks for a total of 6 pulse treatments. The primary outcome was complete remission (proteinuria with protein excretion <0.3 g/24 h, serum albumin ≥3.5 g/dL, normal urinary sediment, and normal or stable serum creatinine level) at 6 months. Response (complete or partial remission), clinical parameters, and adverse effects were secondary end points. After the 6-month induction therapy, the tacrolimus group achieved higher cumulative probabilities of complete remission and response (52.4% vs 38.5% and 90.5% vs 82.1%, respectively) than the intravenous cyclophosphamide group, but differences were not statistically significant (log-rank test, P = 0.2 and P = 0.7, respectively). Proteinuria (log-transformed) was significantly decreased in tacrolimus- versus intravenous cyclophosphamide-treated patients after the first month of treatment, even with adjustment for baseline proteinuria (protein excretion, 0.01 vs 0.23 g/d; P = 0.02). After treatment, serum creatinine levels and estimated glomerular filtration rates were not significantly different between treatment groups. Adverse effects, such as leukopenia and gastrointestinal symptoms, were less frequent in the tacrolimus group. **Conclusions:** In conjunction with prednisone, induction therapy with tacrolimus is at least as efficacious as intravenous cyclophosphamide and prednisone in producing complete remission of lupus nephritis and has a more favorable safety profile.

LITERATURE REVIEW

Mortality and cardiovascular risk associated with different insulin secretagogues compared with metformin in type 2 diabetes, with or without a previous myocardial infarction: a nationwide study.

Tina Ken Schramm, Gunnar Hilmar Gislason, Allan Vaag et al. *European Heart Journal* 2011, 10, page 1093

The impact of insulin secretagogues (ISs) on long-term major clinical outcomes in type 2 diabetes remains unclear. Authors examined mortality and cardiovascular risk associated with all available insulin secretagogues compared with metformin in a nationwide study in patients of type II diabetes. All Danish residents >20 years, initiating single-agent ISs or metformin between 1997 and 2006 were followed for up to 9 years (median 3.3 years) by individual-level linkage of nationwide registers. All-cause mortality, cardiovascular mortality, and the composite of myocardial infarction (MI), stroke, and cardiovascular mortality associated with individual ISs were investigated in patients with or without previous MI by multivariable Cox proportional-hazard analyses including propensity analyses. A total of 107 806 subjects were included, of whom 9607 had previous MI. Compared with metformin, glimepiride (hazard ratios and 95% confidence intervals): 1.32 (1.24-1.40), glibenclamide: 1.19 (1.11-1.28), glipizide: 1.27 (1.17-1.38), and tolbutamide: 1.28 (1.17-1.39) were associated with increased all-cause mortality in patients without previous MI. The corresponding results for patients with previous MI were as follows: glimepiride: 1.30 (1.11-1.44), glibenclamide: 1.47 (1.22-1.76), glipizide: 1.53 (1.23-1.89), and tolbutamide: 1.47 (1.17-1.84). Results for gliclazide [1.05 (0.94-1.16) and 0.90 (0.68-1.20)] and repaglinide and [0.97 (0.81-1.15) and 1.29 (0.86-1.94)] were not statistically different from metformin in both patients without and with previous MI, respectively. Results were similar for cardiovascular mortality and for the composite endpoint. **Conclusion** Monotherapy with the most used ISs, including glimepiride, glibenclamide, glipizide, and tolbutamide, seems to be associated with increased mortality and cardiovascular risk compared with metformin. Gliclazide and repaglinide appear to be associated with a lower risk than other ISs.