

# Clinical results and mechanisms of MAGCELL<sup>®</sup>-therapy in Chemotherapy-induced peripheral neuropathy (CIPN)

Electrode-free electrotherapy also known as MAGCELL<sup>®</sup>-therapy, arrived in the UK and Ireland in 2017 via exclusive distributors PhysioPod<sup>®</sup> UK Limited. This article, explains the clinical results and mechanism of MAGCELL<sup>®</sup> MICROCIRC in CIPN with scientific references.

MAGCELL<sup>®</sup> MICROCIRC can positively influence symptoms of neurotoxicities like sensory ataxia, neuropathy and neuropathic pain symptoms (especially CIPN I-IV) on hands and feet as a result of chemotherapy. Moreover a significant increase in nerve conductivity speed (ulnar nerve) was achieved by the treatment. Sufferers are now able to apply this effective treatment at home via the personal unit, due to repeatable short-treatment periods, no side effects and even through textile (shoes).

## BACKGROUND

MAGCELL<sup>®</sup> is a portable hand device for electrode-free electrotherapy. A sinusoidal pulsating electromagnetic field (PEMF) is generated over the special magnet arrangement and device function principle. However, with a value of 0,105 tesla field strength it is many times higher than for commercially available magnetic field therapy devices with coils or mats, which generally operate with field strengths of maximum 100 gauss or 0.01 tesla. By contrast MAGCELL<sup>®</sup>-therapy units produce field strengths, which are generally stronger by factor 10 than these devices.

According to induction law induced time-variable magnetic fields induce electric fields. The physical effects of MAGCELL<sup>®</sup> derive from the electric fields produced in living cells and tissue based on induction law. Depending on tissue conductivity the field incites an electric current. Taking into account the specific conductivity for various body tissue and liquids, this electric current can be calculated [1,2]. Its strength, or more precisely, current density (= current strength per area, A/m) determines biological effectiveness.

All calculated current densities exceed 10 mA/m and are thus within the range of effects internationally confirmed and classified as 'good': above the 'subtle biological effects' and within the range of 'confirmed macro effects' (10-100 mA/m) [3]. Induced current densities are much higher again in blood and body fluids. The term 'electrode-free electrotherapy' for MAGCELL<sup>®</sup> derives from the distinctly strong induced current densities and exceeding of the



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threshold value of 10 mA/m: both of which are not found on equipment using coils or mats.

Body fluids (e.g. joint fluid) play a key role in the relevant therapy indications for MAGCELL<sup>®</sup> devices. The cells in this fluid or adjacent tissue are exposed to the established current densities. MAGCELL<sup>®</sup> exceeds by far the recognised effective current densities so that treatment is effective even at a tissue depth of 3-5 cm.

MAGCELL<sup>®</sup> also induces above-threshold current densities in the blood, which are crucial for clinical therapy effects, for instance in respect of blood flow stimulation and immunomodulatory processes. The same applies for interstitial liquids, which moreover are found in virtually all organs and tissue. In bones and fatty tissue with low conductivity current densities are well below the effectiveness threshold of 10 mA/m, so a therapeutic effect in this tissue can scarcely be envisaged.

With its peak value of 210 mT, the field strength of the MAGCELL<sup>®</sup> devices only barely (factor 5) undercuts the value of so-called transcranial magnetic stimulation (TMS), a diagnostic method for testing the integrity of nerve tracts, which is being used therapeutically as well by now.



FIG 1: MAGCELL® MICROCIRC: effective treatment at home, no side effects and even through textile (shoes).

The following effects of electrode-free electrotherapy with MAGCELL® are clinically recorded:

- Reduction of sensory neurotoxicities in Chemotherapy-induced peripheral neuropathy (CiPN) [4,5]
- Pain alleviation and movement stimulation e.g. in case of osteoarthritis [6]
- Substantial improvement in blood circulation [7]
- Improved blood perfusion of prostata and volume reduction in benign prostatic hyperplasia (BPH) – animal study! [9]

#### REDUCTION OF SENSORIC NEUROTOXICITIES - CiPN (CHEMOTHERAPY-INDUCED PERIPHERAL NEUROPATHY)

• A phase II pilot study by Geiger et al. [4] in 20 patients with cytostatics-induced polyneuropathy (CiPN) investigated the clinical efficacy and possible side effects of treatment with MAGCELL® MICROCIRC devices on hands and feet. Prior to start of the treatment (IX) and after completion of the same (CX), data were collected using standardised methods, i.e. severity of the PNP was determined using the Common Toxicity Criteria (CTC) questionnaire by the National Cancer Institute, and NCV (nerve conduction velocity) measurements by sensory neurography on the ulnar and sural nerves. A locally significant improvement in each of the parameters of sensory ataxia, neuropathy and neuropathic pain symptoms (from 5.0 P to 4.0 P) was seen from IX to CX. The results were substantiated by a locally significant increase in the nerve conduction velocity of the ulnar nerve from 48 m/s to 52 m/s. At the sural nerve, there was a significant increase in nerve conduction velocity from 24 m/s to 30 m/s. Based on the phase II pilot study, the authors conclude that the symptoms of CiPN are positively influenced by MAGCELL® therapy on the hands and feet, and this may represent a future treatment option for these patients.

• The objective of a subsequent phase III RCT (randomised, double-blind, placebo-controlled) by Rick et al. [5] in 44 patients (21 verum and 23 placebo) was determination of the influence of MAGCELL® MICROCIRC therapy in CiPN of severity I-IV on the basis of measurable neurophysiological qualities. The primary clinical outcome was NCV at the end of the study (T3). Secondary outcomes included the CTCAE Score and Pain Detect End Score, also at T3. The CTCAE score decreased with high statistical significance within both groups. However, these differences were

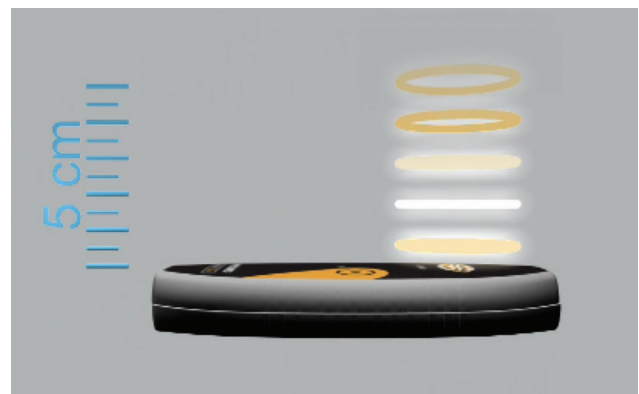


FIG 2: MAGCELL® exceeds recognised effective current densities; treatment is effective even at a tissue depth of 3-5cm

#### COMMON TOXICITY CRITERIA (CTCAE)

Source: Rick et al. (2016)

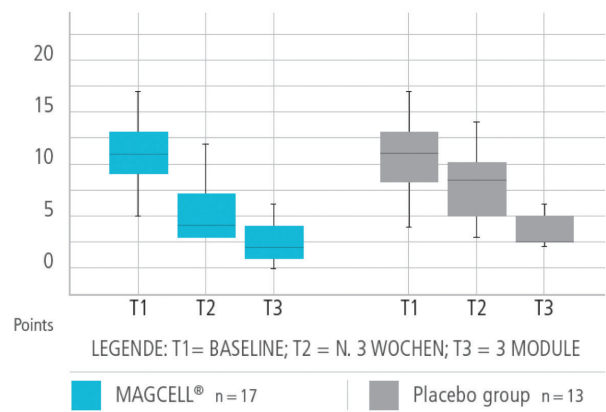


FIG 3: Significant improvement was achieved in terms of the patients' subjectively perceived neurotoxicity (CTCAE score), but not of neuropathic pain. From data in the randomized study presented here, a positive effect on the reduction of neurotoxicity can be assumed for the MFT device. Patients with sensory neurotoxicity in the lower limbs, especially, should therefore be offered this therapy.

not significantly different in the comparison of the two groups. Yet there was a locally statistically significant difference in favour of the verum group at each of measurement times T2 and T3.

Measurement of sensory neuropathy of the ulnar nerve at times T1 and T2 showed a statistically significant improvement in mean NCV from 49 m/s to 55 m/s in the verum group; this effect was also locally statistically significant in comparison with the placebo group. While there was no significant difference in the verum group between times T2 and T3, a significant improvement was observed in the placebo group from time T2 with 50 m/s to 58 m/s at time T3, but without significant intergroup difference. The NCV of the N. peroneus showed pathological values for both groups at all three measurement times. Sensory neuropathy of the peroneus nerve likewise showed a significant improvement in mean NCV in patients in the verum group. While a mean value of only 18 m/s was measured at time T1, at time T2 a mean NCV of 28 m/s was found. This difference missed significance only barely. At the end of the study (T3), there was another significant improvement in NCV to 40 m/s, compared to 27 m/s at T2. At time T3, there was a significant intergroup difference in favour of the verum group. There was a significant decrease in neuropathic pain in both groups over the course of time according to the Pain Detect End scores, but with no significance for the intragroup differences and the intergroup differences with regard to the scores at the individual measurement times. The authors attest therapy with MAGCELL® MICROCIRC a positive effect with regard to the reduction of neurotoxicity and advocate application of the therapy in particular to III° sensory neurotoxicities of the lower extremities.

• Improvements in CIPN-related paraesthesias and reduced NCVs are at least partially due to impairments of axonal transmitter transport within existing peripheral nerves, as well as deficiencies in the repair of impaired or damaged neuronal processes and in wound healing. Potential improvements from the intervention with MAGCELL® may be due to restoration of compromised nerve structures and neuronal processes [8]. Such mechanisms could be detected in vitro with MAGCELL®. Here, long-term investigations by the research group led by Prof. Funk (TU Dresden) show good results with MAGCELL® exposure times of 5–10 minutes per exposure at 3–5 applications daily.

#### OUTLOOK: FURTHER CLINICAL EFFECTS

• The canine prostate is used as an animal model for abnormalities in the growth of the human prostate. In a pilot study in 20 dogs, Leoci et al. [9] studied effects of MAGCELL®-MICROCIRC on blood supply to the prostate and symptoms of manifest benign prostatic hyperplasia (BPH). Before the start of treatment and after the end of treatment, among other things the parameters of prostate volume, blood flow (by Doppler ultrasonography), libido, testosterone level and semen quality (plasma volume, composition and pH) were determined. The 3-week treatment with MAGCELL® resulted in significant reduction of the prostate volume (median: by 57%) without affecting sperm quality, testosterone behaviour or libido. The Doppler examinations of the blood flow of the dorsal branch of the prostatic artery revealed, among other things, reduction in peripheral resistance and a progressive Doppler assessment of maximum systolic and end-diastolic maximum velocity and mean blood flow rate during the study, while the pulsatility and resistive indices remained unchanged. From the efficiency in BPH in dogs,

NERVE CONDUCTION VELOCITY (NCV) N. PERONEUS  
Source: Rick et al. (2016)

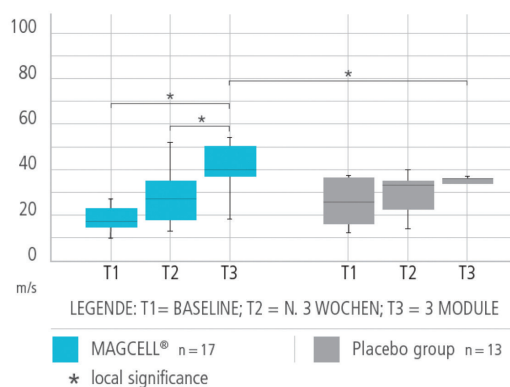


FIG 4: The primary endpoint was nerve conduction velocity (NCV). For the n. peroneus there was a statistical improvement between T1 and T3 as well as T2 and T3 in the MAGCELL® group. When comparing the groups there was a significant difference at T3 for the benefit of the MAGCELL® group.

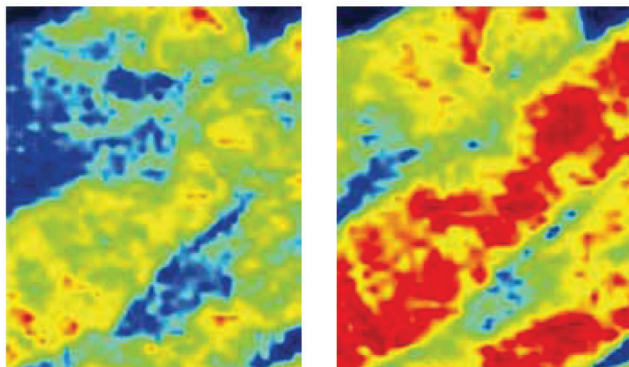
the authors infer a possible human suitability of the otherwise side-effect-free therapy. According to the authors, the results further support the hypothesis that impaired blood supply to the lower urinary tract could be a causal factor in the development of BPH.

- A clinical and experimental study by Funk et al. [7] shows that MAGCELL® MICROCIRC also has a significant microcirculation-enhancing effect in Microvessels with nitric oxide (NO) acting as a vasodilator. Blood perfusion was quantified on fingers using the laser Doppler perfusion imaging technique and nitric oxide (NO) release was measured by fluorescence markers, and measurement in cell cultures (human endothelial cells – HUVEC). Application to HUVEC cultures resulted in rapid onset of action and significant nitric oxide (NO) secretion after 15 minutes.

- Thus, the increase in microcirculation can be explained. The authors recommend the therapy for clinical situations where improvement in microcirculation is indicated, such as chronic wound healing disorders.

#### BLOOD FLOW STIMULATION

Source: Funk et al. (2014)



1. Control (without MAGCELL® MICROCIRC) 2. Two minutes after treatment with MAGCELL® MICROCIRC

**FIG5: Blood flow stimulation: MAGCELL® MICROCIRC significantly increases micro-circulation ( $p < 0,001$ ) while nitric oxide (NO) has a blood vessel dilatory effect. The authors recommend the therapy for clinical situations where an improvement in micro circulation is identified, like for instance in the case of chronic tissue repair.**

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