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*Lasers Surg Med.* 2019 Jan;51(1):47-53. doi: 10.1002/lsm.23039. Epub 2018 Dec 14.

# Induction of fat apoptosis by a non-thermal device: Mechanism of action of non-invasive high-intensity electromagnetic technology in a porcine model

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PMID: 30549290 PMID: [PMC6590311](#) DOI: [10.1002/lsm.23039](#)

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## Abstract

**Objectives:** While controlled thermal changes in subcutaneous tissue have been used to trigger apoptosis of fat cells and have been proven clinically efficacious, another mechanism of electromagnetic stress suggests that fat apoptosis could be achieved by a non-thermal manner as well. This animal model study investigates the use of a non-invasive high-intensity magnetic field device to induce apoptosis in fat cells.

**Methods:** Yorkshire pigs (N = 2) received one treatment (30 minutes) in the abdominal area using a High-Intensity Focused Electromagnetic (HIFEM) device. Punch biopsy samples of fat tissue and blood samples were collected at the baseline, 1 and 8 hours after the treatment. Biopsy samples were sectioned and evaluated for the levels of an apoptotic index (AI) by the TUNEL method. Statistical significance was examined using the rANOVA and Tukey's test ( $\alpha$  5%). Biopsy samples were also assessed for molecular biomarkers. Blood samples were evaluated to determine changes related to fat and muscle metabolism. Free fatty acids (FFA), triacylglycerol (TG), glycerol and glucose (Glu) were used as the main biomarkers of fat metabolism. Creatinine, creatinine kinase (CK), lactate dehydrogenase (LDH) and interleukin 6 (IL6) served as the main biomarkers to evaluate muscle metabolism.

**Results:** In treated pigs, a statistically significant increase in the apoptotic index (AI) ( $P = 1.17E-4$ ) was observed. A significant difference was found between AI at baseline (AI = 18.75%) and 8-hours post-treatment (AI = 35.95%). Serum levels of fat and muscle metabolism indicated trends (FFA  $-0.32 \text{ mmol} \cdot \text{l}^{-1}$ ,  $-28.1\%$ ; TG  $-0.24 \text{ mmol} \cdot \text{l}^{-1}$ ,  $-51.8\%$ ; Glycerol  $-5.68 \text{ mg} \cdot \text{l}^{-1}$ ,  $-54.8\%$ ; CK  $+67.58 \mu\text{kat} \cdot \text{l}^{-1}$ ,  $+227.8\%$ ; LDH  $+4.9 \mu\text{kat} \cdot \text{l}^{-1}$ ,  $+35.4\%$ ) suggesting that both adipose and muscle tissue were affected by HIFEM treatment. No adverse events were noted to skin and surrounding tissue.

**Conclusions:** Application of a high-intensity electromagnetic field in a porcine model results in adipocyte apoptosis. The analysis of serum levels suggests that HIFEM treatment influences fat and muscle metabolism. *Lasers Surg. Med.* 51:47-53, 2019. © 2018 The Authors. *Lasers in Surgery and Medicine* Published by Wiley Periodicals, Inc.

**Keywords:** HIFEM; apoptosis; fat disruption; magnetic technology; non-thermal.

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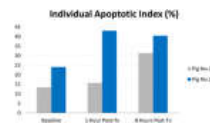
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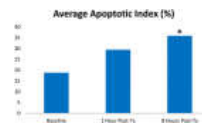
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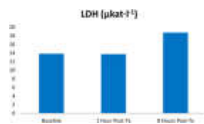
**Figure 1** Histological examination of apoptosis in...



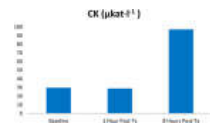
**Figure 2** Average AI (%) evaluated in...



**Figure 3** Average AI (%). In treated...



**Figure 4** Increase of LDH catalytic activity...



**Figure 5** Increase of CK catalytic activity...

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