WILEY CLINICAL ORAL IMPLANTS RESEARCH

Circulatory leukotriene changes during bone healing following Er:YAG laser and piezosurgery osteotomies-an animal study

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Background: Piezosurgery and different types of high-energy lasers have been investigated in bone surgery. Immediate physiologic response to bone injury is a local and systemic inflammatory reaction. The biologically relevant metabolites of arachidonic acid are the families of prostaglandins, thromboxanes, leukotrienes, and lipoxins. Among them, leukotrienes (LTs) are the most prominent molecules with a wide variety of functions. There are no reliable data concerning LTs metabolism during bone healing after Er:YAG laser or piezosurgery osteotomies.

Aim/Hypothesis: The objective of the present study was to analyse the healing of the bone tissue treated with the short-pulsed infrared erbium-doped yttrium aluminium garnet laser in contact and non-contact mode and piezosurgery in relation to circulatory leukotriene B4 (LTB4) and Cysteinyl leukotrienes (Cys-LTs) (LTC4, LTD4, LTE4 and LTF4).

Material and Methods: Twenty-four 10-week-old adult male Wistar rats were used in the study. Osteotomies on both rat's tibiae were performed under general anaesthesia by an intraperitoneal injection of thiopental sodium. Three osteotomies were performed always in the same sequence: digitally controlled non-contact Er:YAG laser, piezosurgery and contact Er:YAG laser. The osteotomies were 5 mm away from each other and 2 mm deep, with a same diameter. Animals from the first group were euthanised immediately after performing osteotomies, with an overdose of anaesthetic solution. The animals from the second group were sacrificed after 1 week, from the third group after 2 weeks and from the fourth group after 3 weeks, all with an anaesthetic overdose. After euthanasia blood was taken from the abdominal aorta and collected for further analysis of leukotriene B4 and cysteinyl leukotrienes. Bone healing after osteotomy was analysed using a laser-based profilometric system and compared to circulatory leukotrienes level.

Results: The circulating levels of both LTB4 and Cys-LTs at 7 and 14 days after osteotomies, were significantly decreased in comparison with the initial ($P < 0.001$ for LTB4 and $P < 0.05$ for Cys-LTs). On the 21st day after surgical treatment only circulating levels of the LTB4 were significantly decreased compared with those on the day 7 ($P < 0.001$) and 14 ($P < 0.05$) and then on the day 21 after surgical procedures they were close to the initial ($P = 0.912$). Circulatory Cys-LTs after day 21 were slightly increased compared with those on the day 7 and 14, but still didn't reach the levels of the initial group ($P = 0.112$). On the 21st day, there were negative significant correlation between LTB4 and reduction in osteotomy volume for all three surgical treatments ($P = 0.012$,  = −0.431, related to piezosurgery; $P = 0.045$,  = −0.398, related to Er:YAG contact mode and $P = 0.033$,  = −0.342 related to Er:YAG non-contact mode, respectively). The circulating Cys-LTs, showed negative significant correlation with the reduction in the osteotomy volume only after Er:YAG contact mode ($P = 0.018$,  = −0.456).

Conclusions and Clinical Implications: It is clear that the applied surgical techniques foster mechanisms of LT's suppression. Taking the fact that different players (especially products of the cyclooxygenases), are involved in the regulation of the LT's production during the process of bone healing, further studies are needed to reveal exact mechanisms involved in different phases of the bone healing process after an Er:YAG or piezosurgery osteotomy. This can help in the development of new approaches that will target partial LTs and will effectively improve the bone healing at whole.