Cell Proliferation in Bone Marrow
Following Surgical Extraction of Teeth:
A Pilot Study

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(Received 23 October and accepted 6 November 1989)

Key words: surgical extraction, mitotic activity, bone marrow

Abstract

Extraction of teeth in rats was found to stimulate increased mitotic activity in bone marrow for 2 days after extraction. The cause of this increased mitosis might be release from the extraction site of kinins, factors which are known to stimulate mitosis in the bone marrow or a general whole-body response to trauma.

Introduction

The bone marrow is one of the major active hematopoietic components of mammals. It plays an important role in hematopoiesis and defense against infections. Mitotic stimulation in rat bone marrow has been reported following standardized bleeding[1], administration of parathyroid hormone[2,3], and injection of calcium[2] and kinins[4]. Autoradiographic studies of the proliferative response of osteogenic cells in mice with fractures have shown a mitogenic effect of osteoblasts in the fractured bone, and also to a certain degree even in the contralateral bone[5,6].

In the present study, the possible stimulatory effect of surgical tooth extraction on the mitotic activity of rat bone marrow was investigated.

Materials and Methods

Seventy-two inbred Sprague-Dawley rats weighing 100-200 g were used. They were divided into control and surgical extraction groups. In rats of the latter group the molar teeth of the left maxilla were extracted surgically under ether anesthesia. In the control group, the animals were subjected to ether anesthesia only. The rats were kept in cages and provided with food ad libitum. In the experimental group the animals were sacrificed at 6 h and at 1, 2, 3, 4, 7 and 15 days after extraction. The rats in both the control and experimental groups were given two injections of colchicine intraperitoneally, the first 6 h (0.2 mg/100 g body wt.) and the last 3 h (0.2 mg/100 g body wt.) before sacrifice with ether. Two injections of colchicine were done to ensure that cells in metaphase did not escape the initial block. All animals were given the injections at the same time, the first injection being at 0800-0830 h, in order to avoid any circadian fluctuations in bone marrow mitotic activity.

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activity. The femoral bones were removed, and bone marrow suspensions were prepared in a balanced glucose-salts medium (5.5 mM glucose, 5.0 mM KCl, 0.63 mM CaCl$_2$, 1.0 mM MgSO$_4$, 5.0 mM Na$_2$HPO$_4$, 120 mM NaCl, 5.0 mM Tris buffer, pH 7.2). To prepare the suspensions of bone marrow cells, the ends of each femoral bone were removed and the core of the marrow was washed out with 1.5 ml of the medium. The cells were dispersed by passing the tissue through a syringe fitted with an 18-gauge needle, and then the suspensions were gently centrifuged. Samples of the cell suspensions were placed on slides, fixed immediately in ethanol and stained with hematoxylin-eosin. The slides were scored for the percentages of the total cell population in metaphase, each preparation consisting of two slides and at least 500 cells being counted on each (i.e. a total of at least 1,000 cells were counted). The results were analyzed by Student’s t test.

Results

In control animals after the first colchicine injection, 14.5% of the total bone marrow population was arrested in metaphase. This corresponds to the results of Perris, Whitfield and Rixon[2]. In the bone marrow of the extraction group, significantly increased mitotic activity was observed for a longer period than in the control rats, i.e. 16.9% after 24 h (p<0.001), 17.3% after 48 h (p<0.001), and 16.0% after 4 days (p<0.001), and slightly below the normal values after 7 and 15 days (14.43% and 14.40%, respectively).

Discussion

Various types of trauma seem to increase the mitotic activity of bone marrow cells. The present results demonstrated that one day after surgical extraction of teeth in rats, there was an increase in mitotic activity of the bone marrow, and that this increased activity was sustained for approximately 2 days. The mitotic activity was determined after colchicine block, but similar increases in bone marrow mitotic activity can also be produced by standardized bleeding[1], or injection of parathyroid hormone[2] and EDTA[3]. Experiments on parathyroidectomized rats have failed to stimulate mitosis and therefore it seems probable that the parathyroid glands exert a dominant influence on the degree of bone marrow mitosis[1]. On the other hand, the present author considers it more likely that surgical trauma induces release of mitogenic kinins, which act in the same way as kallikrein and bradykinin, stimulating mitosis of the rat bone marrow via cyclic AMP.

Our pilot study has indicated that extraction trauma causes not only local changes but also a systemic response. The production of new cells in bone marrow after surgical tooth extraction may also reflect a general whole-body response to trauma. However, it is also possible that this cellular response has some important purpose in producing cells that migrate into traumatized areas. Without further research, however, these possibilities remain only speculative.

References

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