The effect of fluoride on osteoblast cell population after in vivo administration

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Abstract

Background: The osteoblast is characterized by its ability to synthesize a well defined mineralized collagenous matrix, regulate the remodeling process by synthesizing local hormone, specific molecules and alkaline phosphatase enzyme .The aim of this study was to evaluate the effect of Sodium Fluoride administration in vivo on osteoblast cell.

Materials and methods: Fourteen pregnant Sprague- Dawley rats were used, 8 of them received 100ppm Fluoride, others did not received and considered as controls. Bone biopsies from neonatal rat were studied histologically and histochemically.

Results: Active proliferation of osteoblast and their progenitor cells with active localization of alkaline phosphatase in neonatal jaw bone treated with Sodium Fluoride.

Conclusion: under the condition of the present study, the Sodium Fluoride can be used successfully to enhance bone formation.

Keywords: Osteoblast, alkaline phosphatase, Sodium Fluoride.

Introduction

The effect of fluoride on bone tissues are well documented in recent studies by in vivo and in vitro histologically evaluated on both human and animals bone biopsies (1, 2)

Many authors demonstrated an increase in osteoblast population and they suggested that osteoblast precursors in bone marrow are targets for Fluoride action (3,4)

Data reported by Devogelaer et al in 1995 and Grayeli et al in 2004 (5,6) illustrated that Fluoride has mutagenic effect on osteoblast and stimulated their activity by showing high alkaline phosphatase reaction in animals treated with Fluoride in comparison with control .

Ohhta et al in 1995(7) demonstrated that Fluoride is an osteogenic agent stimulated human cell proliferation and alkaline phosphatase activity in osteoblast cell culture.

It has been reported that Sodium Fluoride (NaF) is the only safe medication so far used clinically available with bone formation stimulating property, as it used in osteoporosis states with fragile bone, liable to fracture. It seems logical that NaF able to restore bone mass without weakening bone strength. (8,9)

The present study was designed to investigate whether NaF would interact with embryonic bone tissue.

Materials and Methods

Fourteen pregnant Sprague – Dawley rats were selected , eight animals received 100 ppm Fluoride as NaF in drinking water for 18-21 days of pregnant period.

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The other animals which did not received NaF were considered as controls. Bone biopsies of the lower jaw from neonatal (one day new born) rats were obtained .Some of them fixed in 10% buffer formalin for histological study by Hematoxylin and Eosin stain, other biopsies prepared for histochemical reaction.

Enzyme histochemical study

Fresh tissue block were mounted using Richert- Jung tissue freezing medium. Fresh frozen section of 10 micron thickness were obtained, using freezing microtome, (Richert –Jung 1205 freezing microtome). The sections were recovered on cover slips

The simultaneous azo coupling method of Reith et al 1978(10) was used to demonstrate alkaline phosphatase. The substrate employed was naphthol AS-BI phosphate (sodium salt) Fluka .Fast blue RR (Fluka) was used as a coupling diazonium salt

Results

Histological feature of neonatal bone jaw of rats treated with NaF shows active proliferate osteoblast cells and active mitotic bone marrow stromal cells , as differ from control one .(figures ,1,2,3)

Histochemical reaction of alkaline phosphatase enzyme demonstrated in osteoblast and bone marrow stromal cells which intensely stained with brown color in comparison with controls (figures, 4,5,6) .

Discussion

Osteoblasts synthesize and mineralize bone matrix and are principle target cells for NaF (11). The present study showed osteogenic effect of NaF , illustrated by osteoblast cell proliferation with their active alkaline phosphatase enzyme .In the same time proliferation of bone marrow osteoprogenitor cells are also detected , therefore , the study hypothesizes that NaF has ability to stimulate progenitor cells for proliferation directly or indirect by activating multiple intracellular signaling mechanisms in which it stimulates and regulates osteoblast differentiation and then its proliferation.

Alkaline phosphatase enzyme is observed to be associated with osteogenic process, in which osteoblast and its progenitor cells give an intense staining reaction at the site in close association with metric synthesizing cells (12,13)

Conclusion

The present study concluded that NaF has osteogenic, mitogenic effect on bone and can be used therapeutically to enhance bone formation in developmental, biophysiological cases and in pathological condition.

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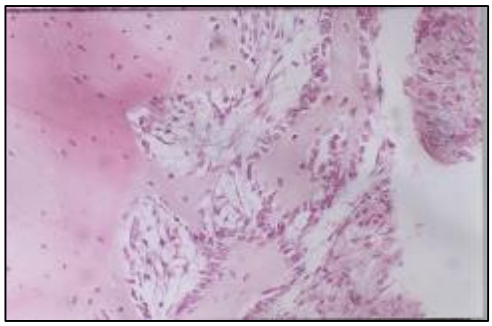
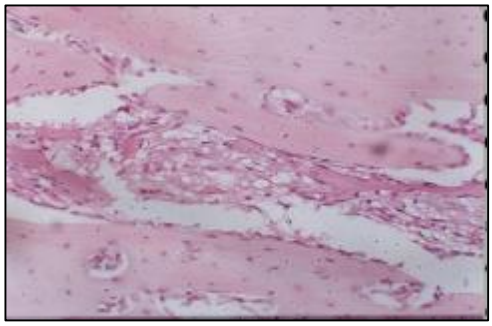


Figure 1



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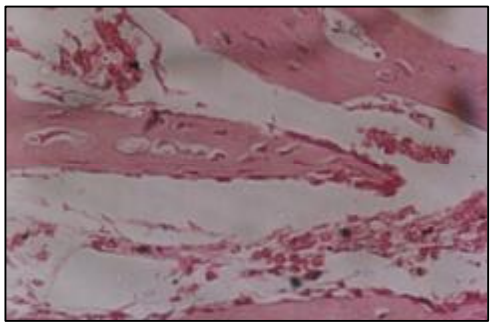

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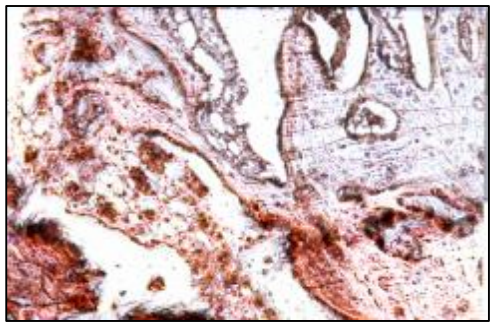
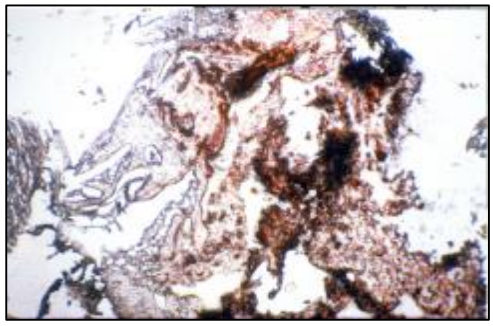


Figure 4



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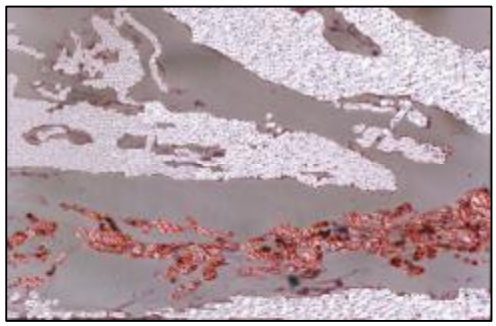

Figure 6