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Review

Efficacy of systemic bisphosphonate delivery on osseointegration of implants under osteoporotic conditions: Lessons from animal studies

Fahim Vohra [a,*], *Mohammad Qasim Al-Rifaiy* [a], *Khalid Almas* [b], *Fawad Javed* [c]

[a] *Department of Prosthetic Dental Sciences, College of Dentistry, King Saud University, PO Box 60169, Riyadh 11545, Saudi Arabia*

[b] *Division of Periodontology, School of Dental Medicine, University of Connecticut, Farmington, CT, USA*

[c] *Eng. A.B. Research Chair for Growth Factors and Bone Regeneration, 3D Imaging and Biomechanical Laboratory, College of Applied Medical Sciences, King Saud University, PO Box 60169, Riyadh 11545, Saudi Arabia*

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ABSTRACT

Background: The aim was to systematically review the role of systemic bisphosphonate (BP) delivery on osseointegration of implants under osteoporotic conditions.

Methods: The addressed focused question was "Does systemic BP delivery enhance osseointegration of implants under osteoporotic conditions?" PubMed/MEDLINE and Google-Scholar databases were searched from 1994 up to and including December 2013 using different combinations of the following keywords: "bone to implant contact", "implant", "bisphosphonate", "osseointegration" and "osteoporosis". Review articles, case-reports, commentaries, letters to the Editor, unpublished articles and articles published in languages other than English were excluded.

Results: Fifteen animal studies fulfilled our eligibility criteria. Osteoporotic conditions were induced via bilateral ovariectomy (OVX). BPs used in the studies were ibandronate, zoledronic acid and alendronate. Results from 12 studies showed that systemic BP delivery significantly increased bone volume and bone-to-implant contact under osteoporotic conditions. Two studies reported no significant difference in osseointegration among OVX animals with and without systemic BP delivery. In one study, systemic BP delivery negatively influenced implant osseointegration. Rough-surfaced and polished implants were used in 11 and one study respectively. In 3 studies implant surface characteristics remained unclear.

* *Corresponding author*. Tel.: +966 14698788; fax: +966 14678639.
E-mail addresses: fahimvohrasa@gmail.com, fahimvohra@yahoo.com (F. Vohra), fawadjaved19@gmail.com, fawjav@gmail.com (F. Javed).

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Conclusion: Within the limits of the present study, it is concluded that systemic BP delivery enhances implant osseointegration in animals with induced osteoporotic conditions. However, in a clinical scenario, the potential risk of BP related ONJ in osteoporotic patients undergoing dental implant therapy cannot be disregarded.

Contents

1. Introduction

Osteoporosis, a metabolic disease of bone, is characterized by reduced bone mineral density (BMD) and bone mass due to impaired bone metabolism.[1,2] In addition, osteoblasts in osteoporotic bone demonstrate impaired proliferative, synthetic and reactive ability to cellular mediators.[1,3,4] Risk-factors of osteoporosis include pre- and postmenopausal oestrogen deficiency, excessive glucocorticoid intake, eating disorders and gene interactions in bone metabolism.[5–8]

Bisphosphonate (BP) therapy is the treatment choice for the management of osteoporosis.[9,10] These drugs act by inhibiting osteoclastic differentiation and maturation thereby leading to their dysfunction. Moreover, bisphosphonates induce osteoclastic apoptosis and reduce bone resorption by down-regulating bone turnover.[11] This translates to improved BMD and structural bone properties and, reduced bone remodelling and risk of fractures in osteoporosis.[12–14]

Dental implants are modern substitutes for fixed and removable dental prosthesis that can osseointegrate and remain functionally stable over long durations.[15,16] However, immunocompromised patients (such as those with poorly controlled diabetes, acquired immune deficiency syndrome and osteoporosis) are more susceptible to implant failure as compared to systemically healthy individuals.[17–19] This may possibly be associated with impairment in bone healing following implant placement in such patients.[18] Furthermore, a reduced BMD decreases bone to implant contact (BIC) and implant-bone shear strength; thereby increasing the risk of implant failure.[17,20,21]

Since BP therapy improve BMD in osteoporotic patients,[22] it is tempting to speculate that BIC and bone volume (BV) are significantly higher around implants placed in osteoporotic patients under systemic BP therapy compared to osteoporotic patients not receiving systemic bisphosphonates. Therefore, the aim of the present study was to systematically review currently available evidence regarding the efficacy of systemic BP delivery on osseointegration of implants under osteoporotic conditions.

2. Materials and methods

2.1. Focused question

The addressed focused question was ''Does systemic BP delivery enhance osseointegration of implants under osteoporotic conditions?''

2.2. Eligibility criteria

The following eligibility criteria were entailed: (a) original studies; (b) clinical and experimental studies; (c) intervention: role of systemic BP delivery in enhancing osseointegration under osteoporotic conditions; (d) use of a control group (ovariectomized [OVX]) animals receiving either placebo or no systemic drug delivery; (e) articles published only in English language. Review articles, case-reports, commentaries, letters to the Editor and unpublished articles were excluded.

2.3. Search strategy

PubMed/Medline (National Library of Medicine, Bethesda, MD) and Google-Scholar databases were searched from 1994 up to and including December 2013 using different combinations of the following keywords: ''implant'', ''bisphosphonates'', ''osseointegration'', ''osteoporosis'' and ''bone to implant contact''. Titles and abstracts of studies that fulfilled the eligibility criteria were screened by the authors and