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Bone marrow derived mesenchymal stem cells with or without injectable calcium phosphate composite restrains osteoporosis in rat model

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Objective: The purpose of the present study was to evaluate the possible therapeutic role of bone marrow mesenchymal stem cells (BM-MSCs) alone or in combination with injectable calcium phosphate composite in management of osteoporosis in ovariectomized rats.

Methods: The MSCs were harvested from femoral bone marrow of male rats, as sex mismatched, to track the MSCs fate and to ensure their homing to the injured females' femurs. The isolated BM-MSCs proved their MSCs identity via their morphological appearance, multilineage potential and the positive expression for CD29, CD44 as well as CD106 and negative expression for CD14, CD34 and CD45. A total number of seventy adult female albino rats were used in the present study. The rats were classified as follows: group 1 was the gonad intact control, group 2 served as untreated ovariectomized (OVX) rats, while the groups from the third to seventh were OVX rats treated with, BM-MSCs, BM-MSCs with injectable bone substitute (IBS), IBS, calcitonin and calcitonin with IBS respectively. Core binding factor alpha-1 (Cbfa-1 or Runx-2) and nuclear factor kappa B (NFκB) gene expression levels in femur bones were detected using real time PCR. Serum osteoprotegerin (OPG) and monocyte chemoattractant protein-1 (MCP-1) were estimated using ELISA technique.

Results: The positive expression of Y-chromosome (SRY) gene detected in the BM-MSCs treated groups indicated that the systemically delivered single dose of undifferentiated MSCs was able to home at the females' femur bones. The expression level of Runx-2 showed down-regulation while that of NF-κB showed up-regulation in femur bones of OVX group. Additionally, serum OPG level was significantly reduced while serum level of MCP-1 was significantly elevated in OVX group as compared to gonad intact control group. The MSCs injection with or without the biphasic calcium phosphate hydroxy-propyl-methyl-cellulose (HMPC) composite produced significant up-regulation of Runx-2 gene expression associated with significant down-regulation of NF-κB gene expression levels in femur bones. Moreover, this type of treatments produced significant increase in serum OPG level associated with significant decrease in serum MCP-1level when compared with the untreated OVX group.

Conclusion: These results demonstrate the usefulness of MSCs in management of osteoporosis. Additionally, the current study spots light on a novel approach of utilizing injectable biphasic calcium phosphate composite with undifferentiated BM-MSCs as a therapeutic application for osteoporosis.

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