OSTEOGENIC POTENTIAL OF EXPERIMENTAL BIOACTIVE SURFACES IN BMP-RESPONSIVE MOUSE OSTEOBLASTIC CELLS AND HUMAN ADIPOSE DERIVED ASC52TELO CELL LINE

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Introduction

We examined composite materials obtained from PLGA copolymer and sol-gel derived bioactive glasses (BG) (TABLE 1). Similar composites have been previously shown by us to display high biocompatibility and some of them can stimulate osteogenesis in human bone marrow stromal cells (BMSC) [3] [4] [6]. In this work, we studied these experimental surfaces in cultures of BMP-responsive mouse osteoblastic cells (BRITER, ATCC) and human adipose tissue derived ASC52telo cell line [8]. Bone morphogenetic proteins (BMPs), especially BMP-2 and -7 are clinically relevant and they are often used in tissue engineering approaches to deliver osteogenic growth factors. On the other hand, adipose-derived mesenchymal stem cells are known for their osteogenic potential although their ability to differentiate into osteoblasts is generally lower than that of BMSC [1] [2] [5] [7]. In this work BRITER cells with and without exogenous BMP-2 were either directly cultured on experimental surfaces or in the presence of condition medium (CM) harvested from the materials (FIG. 1). Similarly, human ASC52telo cells were either directly seeded on the material surfaces or cultured on tissue culture plastic in the presence of CM. Cells were stimulated with osteogenic inducers, including BMP-2 or 1,25(OH)2 VitD3. Osteogenesis was examined by the activity of BMP Response Element (BRE)-dependent Firefly Luciferase (FFLuc) in BRITER cells as well as alkaline phosphatase (ALP) activity in both BRITE and ASC52telo cell lines.

TABLE 1. Chemical composition of BGs incorporated at 50% into PLGA matrix.

SYMBOL	SiO_2 [%]	CaO [%]	P_2O_5 [%]
A1	40	60	-
D1	60	40	-
T1	50	50	-
S1	80	20	-
A2	40	54	6
D2	60	36	4
T2	47	47	6
S2	80	16	4
SiO_2	100	-	-

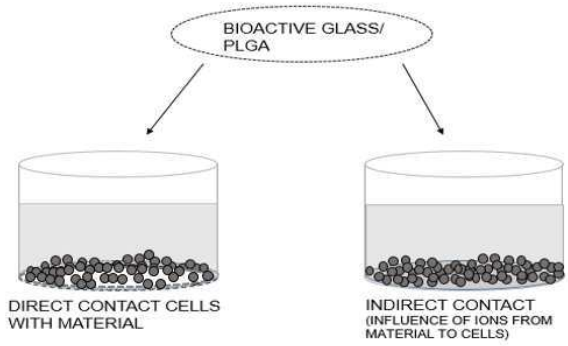

FIG. 1. Experimental scheme.

Materials and Methods

The activity of BMP Response Element (BRE)-dependent Firefly Luciferase (FFLuc) in BRITE cells was examined after 3-hour BMP-2 treatment (100 ng/ml) at day 3 culture, whereas ALP activity in BRITE cells was examined after 14-day culture with and without BMP-2. ASC52telo cells were examined for ALP activity at day 10 culture.

Results and Discussion

BRITER cell treated with BMP-2 significantly increased Luciferase activity in cells grown directly on high-silica materials, but ALP activity was not induced for these materials. Importantly, BMP-2 treatment of cells grown on TCP in the presence of CM harvested from experimental surfaces showed different results and the cells significantly increased Luciferase activity when treated with CM from high-calcium composites. ASC52telo treated with BMP-2 significantly increased ALP activity in cells grown on high-silica material whereas treatment with VitD3 was ineffective to induce ALP activity in any material type except for pure SiO_2 and PLGA. Treatment of ASC52telo cells with CM from experimental surfaces was ineffective to induce alkaline phosphatase activity despite the presence of osteogenic inducers.

Conclusions

Our results indicate important differences in cell response to the experimental surface depending on the cells type as well on the general osteogenic conditions. This is important especially for bone tissue engineering approaches aiming to deliver biomaterial constructs loaded with potentially osteogenic cells. Also, our results indicate the important differences in biological effects obtained with cells grown directly on the material surfaces vs. cells growth in the presence of material dissolution products. It may have important implications regarding the in vivo biomaterial implantation as cell-loaded biomaterials may provide different biological results vs. empty biomaterial scaffolds.

Acknowledgments

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