WITHDRAWAL OF ADULT STEM CELLS FROM ADIPOSE TISSUE OF THE ABDOMEN: A NEW TECHNIQUE

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INTRODUCTION

Regenerative medicine, and particularly stem cell therapy, has rapidly evolved during last years and has become one of the main “one step surgery” choices. Mesenchymal stem cells have been proposed as a potential source of cells for cell-based cartilage repair due to their ability to self-renew and undergo multi-lineage differentiation, and the use has the advantage to avoid primary surgery for cartilage biopsy and subsequent chondrocytes cultivation. Adult mesenchymal stem cells (MSCs) have been mainly isolated from bone marrow, but, recently, adult adipose tissue-derived stromal cells (ADSCs) have received greater interest to reconstruct damaged cartilaginous tissue, because they are easily harvested in large numbers compared to other stem cells sources, since there is no other human tissue expendable as adipose tissue, making it relatively easy to isolate adequate numbers of ADSCs for possible human therapies. Stem and progenitor cells in the uncultured stromal-vascular fraction (SVF) from adipose tissue usually amount to up to 3% of the whole cells, and this is 2,500-fold more than the frequency of stem cells in bone marrow. In 2006, several Authors (Zuk, De Ugarte, Mitchell, Guilak) demonstrated that the number of SVF cells that can be isolated from subcutaneous liposuction aspirates is approximately 0.5-2.0 x 10^6 cells per gram of adipose tissue, whereby the percentages of stem cells range from 1 to 10%, most likely depending on the donor and tissue harvesting site. Therefore, approximately 0.5 x 10^6 to 2 x 10^6 stem cells can be isolated per gram of adipose tissue, varying among patients. Different papers, and especially the very recent by Strioga and coworkers, have cleared that, in clinical applications, ADSCs are as effective as BM-MSCs and that can be differentiated into chondrocyte-like cells and can therefore be useful to treat cartilage defects or cartilage degenerative disease.

MATERIALS & METHODS

Apart from being highly disposable, ASCs can be easily withdrawn by simple liposuction, with low pain and low risks, have demonstrated high proliferative capacity in culture (from 0.5 x 10^5 to 2 x 10^5) and have multi-lineage potential. In particular, several Authors (de Girolamo, Lin, Guilak, and Fraser) have demonstrated the high condrogenic capability of ASCs.

The standard ASCs isolation method, introduced about 10 years ago requiring collagenase lysis, several centrifugation passages specialized equipment and reagents required from 8 to 10 hours to separate adipocytes from the Stromal Vascular Fraction (SVF), containing progenitor and stem cells from adipose tissue. The application of this method of ASCs isolation as made it possible to apply tissue engineering techniques to one step chondral surgeries. In particular we present My Stem system and technique that enables progenitor and stem cell isolation from adipose tissue without collagenase enzymatic lysis through direct culture of mechanically dissociated fragments of adipose tissue (Lattanzi).

DISCUSSION

As Gimble et al. and Liu et al. and, just some months ago, Strioga et al. affirmed, ASCs can nowadays be considered separate but equal to BM-MSCs, since they share many biological characteristics, but present some differences in their immunophenotype, differentiation potential, transcriptome, proteome, and immunomodulatory activity. But ASCs can be obtained more easily, in larger volumes, at lower risks and causing less pain as they are obtained from the waiste product of liposuction, a well known and low risk surgical technique. In fact, Fraser et al. in 2008, have demonstrated that adipose tissue contains 2500 times the progenitor and stem cells contained in bone marrow. In the volume evaluation, Lattanzi has demonstrated that with the technique we present in this study, from a standard lipoaspirate of 50 ml are obtained 15.75 cc of useful SVF (31.5%). The Stromal Vascular Fraction (SVF) isolated from 1 gram of adipose tissue contains mainly 10.0 ± 2.8 x 10^5 viable cells. These, on the basis of Suga et al. paper, in 2008, are represented as follows: MSCs (37 ± 5%) blood cells (37 ± 5,25) and endothelial cells (15 ± 4,9%). Finally, several Authors, in the last years, confirmed the fact that, in clinical applications, ADSCs are as effective as BM-MSCs and that can be differentiated into chondrocyte-like cells and can therefore be useful to treat cartilage defects or cartilage degenerative disease.

CONCLUSIONS

The adipose tissue liposuction procedure is a well known technique, simple and low-risk. At present, My Stem technique provides ASCs withdrawal by the use of a specific blunt-tipped biopsy needle and the direct culture in the OR of the adipose mechanically separated layer of cells, without the need to perform collagenase lysis: these characteristics make it a quick procedure, easy and safe to perform in the OR, perfectly adapting to the timing requested for a single step chondral defect repair procedure. Future clinical, isticological and MRI’s follow-ups will be able to evaluate the results. We retain, however, that it will be a technically implementable technique, with the possible combined use of growth factors and new scaffolds. But the near future will already offer the chance to work with a new closed system, My Stem Evo, where the introduction of a particular filtration device eliminates the need for centrifugation.