Trends in Research

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What should be considered to get a lot of adipose derived stem cells?

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Abstract

Adipose derived stem cells (ASCs) are derived from mesenchyme and have several general or unique characteristics. ASCs have more colony frequency, higher proliferation capacity and can be cultured longer compared with bone marrow-derived mesenchymal stem cells. The yield, frequency of ASCs, the number of viable cells, proliferation and differentiation potential, and growth characteristics of ASCs have various spectrum according to the methods of harvesting, adipose tissue site for harvesting, and patient's individual characteristics.

Introduction

Mesenchymal stem cells (MSCs) play an important role in cellular therapy. The bone marrow is the first source that has been found to have MSCs. Adipose tissue, like bone marrow, is the mesenchymal origin and contains a supportive structure that is easily digested and isolated.

There are several reports regarding comparisons of yield, colony frequency, sustainable duration of cell culture and proliferation between ASCs and BM-MSCs. The yield of ASCs is approximately 5000 CFU-F (colony forming units-fibroblast) per gram of adipose tissue, and this could be compared with 100-1000 CFU-F per millilitre of bone marrow [1]. The bone marrow has a capacity limit of 40ml under local anaesthesia, so 2.4×10^4 stem cells could be obtained from 40 ml volume of human bone marrow. On the other hand, 1×10^6 ASCs can be harvested from 200 ml of adipose tissue under local anaesthesia, so the difference is 40-fold [1]. Moreover, ASCs have a higher colony frequency, longer incubation and higher proliferation capacity than BM-MSCs [2].

ASCs are easier to obtain in large quantities than BM-MSCs and have favourable conditions for culture, but the colony frequency, proliferation and differentiation functions of ASCs differ depending on the harvesting methods, harvesting site, and individual characteristics.

Variations according to the methods of harvesting adipose tissue

Depending on the methods of extracting adipose tissue to obtain ASCs, the yield, number of viable cells and growth characteristics of ASCs may differ. Numerous different procedure and tools for harvesting ASCs-containing fat tissue have been established. Especially, viability of ASCs is one of the important tools to measure the stress applied to adipose tissue during harvesting [3]. Keck et al. have shown that suction- assisted liposuction resulted in yield and viability of ASCs comparable to manual liposuction [4]. Alternatively, laser-assisted liposuction has been demonstrated to decrease ASCs yield and viability as compared with suction-assisted liposuction [3]. Oedayrajsingh-Varma et al reported that the number of viable cells in the SVF was similar regardless of the harvesting procedure, but ASCs obtained by ultrasound-assisted liposuction had a lower frequency of proliferating, a longer population doubling time than ASCs obtained by resection [5]. Conversely, according to study of Duscher et al, ultrasound-assisted liposuction (pulsed ultrasound energy to selectively emulsify subcutaneous adipose tissue) and suction- assisted liposuction showed similar results in terms of yield, viability, and metabolic activity [3].

Variations according to adipose tissue site for harvesting

The anatomical location used for harvesting adipose tissue may also affect the yield, frequency and function of ASCs. The abdomen and hip/thigh area are the most frequently used anatomical sites for harvesting. Oedayrajsingh-Varma et al have found the yield of nucleated cells in the SVF from different tissue-harvesting sites was similar [5]. The frequency of ASCs (determined by limiting dilution and CFU-F) was higher in SVF derived from abdominal fat than in SVF isolated from hip / thigh area [6]. However, differentiating potential, the growth kinetics and surface marker expression of ASCs from both tissue-harvesting sites are similar [6]. ASCs from the same site exhibit differences in cell yield depending on the harvest depth [7].

Characterization of ASCs according to patient's individual variation

The characteristics of ASC may change depending on the age, gender, BMI, and diseases such as diabetes and osteoarthritis of the person from whom subcutaneous fat was obtained [8]. Hauner et al reported no relationship between BMI or age and numbers of ASCs per gram of adipose tissue [9]. However, there are reports that the individual characteristics of patients affect proliferation and differentiation of

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ASCs. Yang et al demonstrated that increased age led to decreased cell yield cell, growth ASCs proliferation and adipogenic differentiation [8]. They also found that BMI did not affect the cell yield or growth rate but did affect differentiation [8]. The inconsistency of the effects of individual characteristics on the yield, proliferation, and differentiation of ASCs may be due to confounding factors such as varied fat extraction methods, processing methods, and culture conditions.

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