Stem Cell Research Literatures

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Abstract: Stem cells are derived from embryonic and non-embryonic tissues. Most stem cell studies are for animal stem cells and plants have also stem cell. Stem cells were discovered in 1981 from early mouse embryos. Stem cells have the potential to develop into all different cell types in the living body. Stem cell is a body repair system. When a stem cell divides it can be still a stem cell or become adult cell, such as a brain cell. Stem cells are unspecialized cells and can renew themselves by cell division, and stem cells can also differentiate to adult cells with special functions. Stem cells replace the old cells and repair the damaged tissues. Embryonic stem cells can become all cell types of the body because they are pluripotent. Adult stem cells are thought to be limited to differentiating into different cell types of their tissue of origin. This article introduces recent research reports as references in the related studies.

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Introduction

The stem cell is the origin of an organism's life that has the potential to develop into many different types of cells in life bodies. In many tissues stem cells serve as a sort of internal repair system, dividing essentially without limit to replenish other cells as long as the person or animal is still alive. When a stem cell divides, each new cell has the potential either to remain a stem cell or become another type of cell with a more specialized function, such as a red blood cell or a brain cell. This article introduces recent research reports as references in the related studies.

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Faast, R., et al. (2006). "Use of adult mesenchymal stem cells isolated from bone marrow and blood for somatic cell nuclear transfer in pigs." Cloning Stem Cells **8**(3): 166-173.

Mesenchymal stem cells (MSCs) isolated from bone marrow were used to examine the hypothesis that a less differentiated cell type could increase adult somatic cell nuclear transfer (SCNT) efficiencies in the pig. SCNT embryos were produced using a fusion before activation protocol described previously and the rate at which these developed to the blastocyst stage compared with that using fibroblasts obtained from ear tissue from the same animal. The use of bone marrow MSCs did not increase cleavage rates compared with adult fibroblasts. However, the percentage of embryos that developed to the blastocyst stage was almost doubled, providing support for the hypothesis that a less differentiated cell can increase cloning efficiencies. As MSCs are relatively difficult to isolate from the bone marrow of live animals, a second experiment was undertaken to determine whether MSCs could be isolated from the peripheral circulation and used for SCNT. Blood MSCs were successfully isolated from four of the five pigs sampled. These cells had a similar differentiation capacity and marker profile to those isolated from bone marrow but did not result in increased rates of development. This is the first study to our knowledge, to report that MSCs can be derived from peripheral blood and used for SCNT for any species. These cells can be readily obtained under relatively sterile conditions compared with adult fibroblasts and as such, may provide an alternative cell type for cloning live animals.

Li, Z., et al. (2013). "Bone marrow mesenchymal stem cells are an attractive donor cell type for production of cloned pigs as well as genetically modified cloned pigs by somatic cell nuclear transfer." Cell Reprogram **15**(5): 459-470.

The somatic cell nuclear transfer (SCNT) technique has been widely applied to clone pigs or to produce genetically modified pigs. Currently, this technique relies mainly on using terminally differentiated fibroblasts as donor cells. To improve cloning efficiency,

only partially differentiated multipotent mesenchymal stem cells (MSCs), thought to be more easily reprogrammed to a pluripotent state, have been used as nuclear donors in pig SCNT. Although in vitro-cultured embryos cloned from porcine MSCs (MSCs-embryos) were shown to have higher preimplantation developmental ability than cloned embryos reconstructed from fibroblasts (Fs-embryos), the difference in in vivo full-term developmental rate between porcine MSCs-embryos and Fs-embryos has not been investigated so far. In this study, we demonstrated that blastocyst total cell number and full-term survival abilities of MSCs-embryos were significantly higher than those of Fs-embryos cloned from the same donor pig. The enhanced developmental potential of MSCs-embryos may be associated with their nuclear donors' DNA methylation profile, because we found that the methylation level of imprinting genes and repeat sequences differed between MSCs and fibroblasts. In addition, we showed that use of transgenic porcine MSCs generated from transgene plasmid transfection as donor cells for SCNT can produce live transgenic cloned pigs. These results strongly suggest that porcine bone marrow MSCs are a desirable donor cell type for production of cloned pigs and genetically modified cloned pigs via SCNT.

Oh, H. J., et al. (2012). "Comparison of cell proliferation and epigenetic modification of gene expression patterns in canine foetal fibroblasts and adipose tissue-derived mesenchymal stem cells." Cell Prolif **45**(5): 438-444.

OBJECTIVES: This study compared rate of cell proliferation, viability, cell size, expression patterns of genes related to pluripotency and epigenetic modification between canine foetal fibroblasts (cFF) and canine adipose tissue-derived mesenchymal stem cells (cAd-MSC). MATERIALS AND METHODS: Proliferation pattern, cell viability as well as cell size at each passage of cFF and cAd-MSC were measured when cultures reached confluence. In addition, real-time PCR was performed to investigate expression of Dnmt1, HDAC1, OCT4, SOX2, BAX, BCL2 genes with reference to beta-actin gene expression as an endogenous control in both cell lines. RESULTS: cFF and cAd-MSC differed in number of generations, but not in doubling times, at all passages. Mean cell size of cAd-MSC was significantly smaller than that of cFF. Cell viability was significantly lower in cFFs and apoptotic level was significantly lower in cAd-MSC compared to passage-matched cFF. In the expression of genes related to pluripotency and epigenetic modification, level of HDAC1 in cAd-MSC was significantly higher than in cFF, but expression of Dnmt1 did not differ between the two groups. OCT4 and SOX2 were significantly more highly expressed in cAd-MSC compared to cFF. CONCLUSIONS: cAd-MSC have higher stem-cell potential than cFF in terms of proliferation patterns, epigenetic modification and pluripotency, thus cAd-MSC could be more appropriate than cFF as donors of nuclei in somatic cell nuclear transfer for transgenesis.

Oh, H. J., et al. (2014). "Analysis of cell growth and gene expression of porcine adipose tissue-derived mesenchymal stem cells as nuclear donor cell." Dev Growth Differ **56**(9): 595-604.

In several laboratory animals and humans, adipose tissue-derived mesenchymal stem cells (ASC) are of considerable interest because they are easy to harvest and can generate a huge proliferation of cells from a small quantity of fat. In this study, we investigated: (i) the expression patterns of reprogramming-related genes in porcine ASC; and (ii) whether ASC can be a suitable donor cell type for generating cloned pigs. For these experiments, ASC, adult skin fibroblasts (AF) and fetal fibroblasts (FF) were derived from a 4-year-old female miniature pig. The ASC expressed cell-surface markers characteristic of stem cells, and underwent in vitro differentiation when exposed to specific differentiation-inducing conditions. Expression of DNA methyltransferase (DNMT)1 in ASC was similar to that in AF, but the highest expression of the DNMT3B gene was observed in ASC. The expression of OCT4 was significantly higher in FF and ASC than in AF ($P < 0.05$), and SOX2 showed significantly higher expression in ASC than in the other two cell types ($P < 0.05$). After somatic cell nuclear transfer (SCNT), the development rate of cloned embryos derived from ASC was comparable to the

development of those derived using FF. Total cell numbers of blastocysts derived using ASC and FF were significantly higher than in embryos made with AF. The results demonstrated that ASC used for SCNT have a potential comparable to those of AF and FF in terms of embryo in vitro development and blastocyst formation.

Ren, Y., et al. (2014). "Potential of adipose-derived mesenchymal stem cells and skeletal muscle-derived satellite cells for somatic cell nuclear transfer mediated transgenesis in Arbas Cashmere goats." PLoS One **9**(4): e93583.

Somatic cell nuclear transfer is used to generate genetic models for research and new, genetically modified livestock varieties. Goat fetal fibroblast cells (gFFCs) are the predominant nuclear donors in Cashmere goat transgenic cloning, but have disadvantages. We evaluated the potential of goat adipose-derived mesenchymal stem cells (gADSCs) and goat skeletal muscle-derived satellite cells (gMDSCs) for somatic cell nuclear transfer, evaluating their proliferation, pluripotency, transfection efficiency and capacity to support full term development of embryos after additive gene transfer or homologous recombination. gADSCs and gMDSCs were isolated by enzyme digestion and differentiated into neurocytes, myotube cells and insulin-producing cells. Neuron-specific enolase, fast muscle myosin and insulin expression were determined by immunohistochemistry. Following somatic cell nuclear transfer with donor cells derived from gADSCs, gMDSCs and gFFCs, transfection and cloning efficiencies were compared. Red fluorescent protein levels were determined by quantitative PCR and western blotting. 5-Methylcytosine, H4K5, H4K12 and H3K18 were determined immunohistochemically. gADSCs and gMDSCs were maintained in culture for up to 65 passages, whereas gFFCs could be passaged barely more than 15 times. gADSCs and gMDSCs had higher fluorescent colony forming efficiency and greater convergence (20%) and cleavage (10%) rates than gFFCs, and exhibited differing H4K5 histone modification patterns after somatic cell nuclear transfer and in vitro cultivation. After transfection with a pDsRed2-1 expression plasmid, the integrated exogenous genes did not influence the pluripotency of gADSCs-pDsRed2-1 or gMDSCs-pDsRed2-1. DsRed2 mRNA expression by cloned embryos derived from gADSCs-pDsRed2-1 or gMDSCs-pDsRed2-1 was more than twice that of gFFCs-pDsRed2-1 embryos ($P<0.01$). Pregnancy rates of gADSCs-pDsRed2-1 and gMDSCs-pDsRed2-1 recipients were higher than those of gFFCs-pDsRed2-1 recipients ($P<0.01$). With their high proliferative capacity and transfection efficiency, gADSCs and gMDSCs are a valuable cell source for breeding new, genetically modified varieties of livestock by somatic cell nuclear transfer.

The above contents are the collected information from Internet and public resources to offer to the people for the convenient reading and information disseminating and sharing.

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