Evaluation of Bone Marrow Derived Stem Cells and Adipose Derived Stromal Vascular Fraction for Treatment of Osteoarthritis Using an Equine Experimental Model

David D. Frisbie, DVM, PhD, Diplomate ACVS; Chris E. Kawcak, DVM, PhD, Diplomate ACVS; Natasha M. Werpy, DVM; and C. Wayne McIlwraith, BVSc, PhD, Diplomate ACVS

In vivo data collected in goats suggest that intra-articular injection of mesenchymal stem cells (MSCs) stimulates repair of damaged menisci and thus decreases the progression of osteoarthritis (OA). However, using an established equine OA model thought to be driven more by enzymatic mechanisms than joint instability, neither bone derived MSCs nor adipose derived cells (subset of which are MSCs) showed significant improvement in the OA progression measured by pivotal parameters such as lameness, radiographic and gross joint examinations, and articular cartilage morphology. This suggests that the use of MSCs for OA may be best suited in cases where regeneration of soft tissue structures is the main goal in decreasing OA progression. Authors’ address: Gail Holmes Equine Orthopaedic Research Center, Colorado State University, 2503 Bay Farm Road, Fort Collins, CO 80523; e-mail: dfrisbie@colostate.edu (Frisbie). © 2006 AAEP.

1. Introduction

While there are claims that adipose derived stem cells improve horses with osteoarthritis (OA), no controlled clinical studies have been published to date. However, bone marrow derived stem cells expanded in culture have been used to regenerate and/or repair a variety of tissues, but to date, only one study has been published evaluating and showing the in vivo effects of intra-articular stem cell injection on decreasing the progression of OA. However, based on unpublished data, there is some evidence that stem cells have a tropism for fibrillated articular cartilage. Because of this, coupled with the overwhelming capacity of stem cells for regeneration of many tissue types, this study was undertaken.

2. Materials and Methods

This study was a blinded, experimentally controlled, randomized block design that used 24 horses in an established model of OA. On day 0 of the study, bilateral mid-carpal arthroscopic surgery was performed, and OA was induced unilaterally in one mid-carpal joint of all horses. On day 14, horses received either placebo, bone-derived culture expanded stem cells (BDMSCs), or adipose derived stromal-vascular fraction (ADSVF; only a 2–4% sub-
population of the nucleated cells are stem cells). Also on day 14, the horses began a strenuous exercise regimen 5 days/wk for the remaining 8 wk of the study. Pivotal parameters assessed included clinical lameness (AAEP grade), radiographic and gross examinations, and articular cartilage and synovial membrane morphology and synovial fluid prostaglandin E\(_2\) (PGE\(_2\)).

3. Results

All horses completed the study, and no adverse events were recorded. Horses receiving placebo treatment in the OA joint had a significant increase in all of the pivotal parameters. Neither horses receiving BDMSCs or ADSVF in their OA joints showed any significant improvement in any of the same pivotal parameters.

4. Discussion

Based on previous results published by Murphy et al.,\(^1\) use of bone marrow derived mesenchymal stem cells seems to be indicated with loss of soft tissue structures, leading to instability, such as with meniscal damage. Significant improvement in acute OA could not be shown after intra-articular treatment using either BDMSCs or ADSVF and, thus, can not be recommended at this time for use in clinical cases of acute OA.

This study was funded in part by Vet-Stem.

Reference and Footnote


*Alan Smith. Personal communication. 2005.*