Validation of the Osteopenia Sheep Model for Orthopaedic Biomaterial Research

Ding, Ming; Danielsen, C.C.; Cheng, L.; Bollen, Peter; Schwarz, P.; Overgaard, S.

Published in:
55TH ANNUAL MEETING OF THE ORTHOPAEDIC RESEARCH SOCIETY

Publication date:
2009

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Validation of the Osteopenia Sheep Model for Orthopaedic Biomaterial Research
+Ding, M; +Danielsen, CC; +Cheng, L; +Bollen, P; +Schwarz, P; +Overgaard, S
+Dept of Orthopaedics O, Odense University Hospital, Denmark, +Dept of Connective Tissue Biology, University of Aarhus, Denmark, +Biomedicine Lab, University of Southern Denmark, +Dept of Geriatrics, Glostrup University Hospital, Denmark ming.ding@ouh.regionsyddanmark.dk

Introduction: Currently, majority orthopaedic prosthesis and biomaterial researches have been based on investigation in normal animals. In most clinical situations, most patients do not have a normal bone quality that in many cases are due to osteoporosis (OP) even in osteoarthritic joints. Although a variety of ovariectomized (OVX) animals has been used to study osteoporosis, there is a great need for suitable large animal models with adequate bone size that closely resemble osteoporosis in humans.

This study aimed to validate glucocorticoid-induced osteopenia sheep model for orthopaedic implant and biomaterial research. We hypothesized that a 7-month GC treatment together with restricted diet but without OVX would induce osteopenia.

Materials and Methods: Eighteen female sheep were randomly allocated into 3 groups: group 1 (GC-1) received GC treatment (0.60 mg/kg/day methylprednisolone) for 7 months, group 2 (GC-2) received the same treatment for 7 months, and further observed for 3 months without GC; and group 3 served as the control group, and left untreated for 7 months. The sheep were housed outdoors in paddocks, and received restricted diet with low calcium and phosphorus (0.55% calcium and 0.35% phosphorus) and hay.

After sacrifice, cancellous bone specimens from the 5th lumbar vertebra, bilateral distal femur, and bilateral proximal tibia, and cortical bone samples from midshaft femur were micro-CT scanned (vivaCT 40, Scanco Medical AG., Switzerland) to quantify their 3-D microarchitectural properties(2). The cancellous bone samples were then tested compressively (MTS Systems Co., USA), and cortical bone samples after demineralized were tested in tensile to determine their mechanical properties. Serum biomarkers for bone formation (osteocalcin) and resorption (crosslaps) were determined. The results were analyzed statistically, and p<0.05 was considered significant.

Results: After 7 months of GC treatment, vertebral cancellous bone volume fraction was reduced by 36%, trabecular thickness by 30%, and cortical bone (lower). Significant changes in cancellous bone were seen. Cancellous bone of vertebra

In conclusion, after 7 months of GC treatments with restricted diet, the microarchitectural characteritics, mechanical competence, mineralization of the bone tissues, and suppression of bone formation markers were similar to osteoporosis-related changes in humans. A prolonged GC treatment is needed for a long-term observation to keep osteopenic bone. This model resembles long-term GC treated OP model, and might be useful in pre-clinical studies.


Acknowledgement: Danish Research Agency (SSVF-22-04-0705).