Bone healing after autogenous bone grafting using ‘high hydrostatic pressure’ in posterolateral spinal fusion model

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INTRODUCTION:

Reconstruction for bone defects after tumor resection continues to be a challenging topic. Reconstruction with allograft is clinically available. Currently, tumor-bearing bone treated with liquid nitrogen is reported to be alternative source, preserving biomechanical and biological properties. On the other hand, some studies have shown that high hydrostatic pressure (HHP) allows for complete devitalization of tumor-afflicted bone segments, keeping biomechanical and physical properties. Therefore, HHP could be advantageous for bone healing. This study investigated whether autogenous high-pressure-treated bone grafts can heal bone using a posterolateral spinal fusion model in rabbits.

METHODS:

Mature rabbits underwent posterolateral spinal fusion, and autogenous iliac bone was grafted between the bilateral L5/6 transverse processes. The autogenous bone was processed in three groups: high-pressure group (Group P: 200 MPa for 10 min), liquid nitrogen group (Group F: 20 min freezing), and control group (Group C: fresh autogenous bone). After slaughtering at eight weeks (6 rabbits per group) and 12 weeks (5 rabbits per group) postoperatively, bone fusion was evaluated by manual test, X-ray, and MPR CT. The criteria for bone fusion were no movement of the intervertebral space on the manual test, residual bone mass and no bone radiolucency on X-ray, and more than 50% continuity between the transverse processes on CT. The left and right sides were evaluated separately on X-ray and CT (Figure 1, 2).

RESULTS:

The bone fusion rate of the 8-week model was 0% in Group P, 0% in Group F, and 83.3% in Group C on manual test; 91.7% in Group P, 75% in Group F, and 100% in Group C on X-ray; 33.3% in Group P, 16.7% in Group F, and 91.7% in Group C on CT (Figure 3). The residual analysis showed that the bone fusion rate on CT was significantly higher in Group C and lower in Group F. The bone fusion rate of the 12-week model was 70% in Group P, 80% in Group F, and 90% in Group C on CT, and there were no significant differences between the three groups (Figure 4).

DISCUSSION AND CONCLUSION:

This study demonstrated that bone grafts treated with HHP could achieve bone healing. HHP has also been reported to keep biomechanical strength and extracellular proteins. Therefore, HHP is expected to have advantages and superiorities over the existing treatment methods and is a new treatment method for the devitalization of tumor-bearing bone.