Spine

SPINE Volume 38, Number 5, pp 385–391

BASIC SCIENCE

Bone Ingrowth and Vascular Supply in Experimental Spinal Fusion With Platelet-Rich Plasma

Gianluca Cinotti, MD,* Alessandro Corsi, PhD,† Benedetto Sacchetti, PhD,† Mara Riminucci, PhD,† Paolo Bianco, MD,† and Giuseppe Giannicola, MD*

Study Design. Prospective investigation using a posterolateral spinal fusion (PLSF) model in rabbits.

Objective. To assess the effects of platelet-rich plasma (PRP) alone, or with uncultured bone marrow, on bone ingrowth and angiogenesis in experimental PLSF.

Summary of Background Data. PRP is an autologous substance potentially beneficial to spinal fusion, because it includes several growth factors that may stimulate bone ingrowth and angiogenesis. However, the results of experimental and clinical investigations on the effectiveness of PRP in spinal fusion are controversial. This study was aimed at analyzing the influence of PRP on bone ingrowth and angiogenesis in experimental PLSF.

Methods. Twenty White New Zealand rabbits underwent PLSF at L4–L5 level. The graft material included a ceramic carrier (Pro-Osteon 500R) loaded, in 7 rabbits, with PRP alone on the right side (Group 1A) and with uncultured bone marrow in the left side (Group 1B). In 7 rabbits, the ceramic carrier was used alone in the right side (Group 2A), and with uncultured bone marrow in the left side (Group 2B). Six rabbits (Group 3) were sham operated on both right and left sides. Six months after surgery, the lumbar spine was harvested *en bloc* and evaluated by high-resolution radiographs (Faxitron, Wheeling, IL) and histology.

Results. The radiographical outcome showed a fusion rate of 86% in Groups 1A, 1B, and 2B and a fusion rate of 71% in Group 2A. No specimen showed a solid fusion in the sham group. Histological analysis revealed new bone formation in the periapophyseal area in Groups 1 and 2, but a complete bony bridge between the transverse processes was not observed in any specimen. In all groups, vascular density was significantly greater in the peri- compared with the interapophyseal region. In the PRP group, there was no evidence of increased vascular density in the grafted material compared with the other groups.

Conclusion. In experimental PLSF model in rabbits, PRP was not effective in promoting new bone formation and vascularization.

Key words: posterolateral spinal fusion, animal model, rabbit, platelet-rich plasma, uncultured bone marrow. **Spine 2013;38: 385–391**

Experimental posterolateral spinal fusion (PLSF) in rabbits is one of the most commonly used animal models to test new bone substitutes.[1] It is considered a challenging model because the transverse processes in rabbits are extremely thin, the space to be filled with bone is greater than critical, and in order to achieve a complete bony bridge between the transverse processes, bone formation has to occur both orthotopically (periapophyseal region) and heterotopically (interapophyseal region).[2]

In recent years, platelet-rich plasma (PRP), a concentrate of platelets in a small volume of plasma, has been introduced in regenerative medicine. The rationale is that, upon activation by an agonist, platelets release various growth factors that have shown osteoinductive and angiogenetic capabilities.[3–15] However, the effectiveness of such a material in experimental and clinical setting is still controversial.[12,15–17]

In a previous investigation on experimental PLSF in rabbits, vascular density was found to reduce from the periapophyseal to the interapophyseal regions, indicating that a gradient of vascularization exists from the periphery to the central region of the bed graft.[2] It has been suggested that the poor vascularization of the interapophyseal region may be a critical step in the spinal fusion process which may hamper the formation of a complete bony bridge between the transverse processes.[2]

In this investigation, we analyzed whether PRP loaded into a porous ceramic carrier is an effective biomaterial, alone or with uncultured bone marrow, to promote bone formation in an experimental model of PLSF. In addition, as no study assessed the effects of PRP on bed graft vascularization in

From the *Department of Anatomy, Histology, Legal Medicine and Orthopaedics, University 'La Sapienza,' Piazzale Aldo Moro, Rome, Italy; and †Department of Experimental Medicine, University 'La Sapienza,' Viale Regina Elena, Rome, Italy.

Acknowledgment date: June 1, 2012. First revision date: July 30, 2012. Acceptance date: August 3, 2012.

The manuscript submitted does not contain information about medical device(s)/drug(s).

No funds were received in support of this work.

No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

Address correspondence and reprint requests to Gianluca Cinotti, MD, Department of Anatomy, Histology, Legal Medicine and Orthopaedics, University 'La Sapienza,' Piazzale Aldo Moro 5, 00185 Rome, Italy; E-mail: md3581@mclink.it

DOI: 10.1097/BRS.0b013e31826dc6d4