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Preparing Decellularized Scaffolds from Ovine Peripheral Nerves and Evaluating their Histological Features and Mechanical Properties for Use in Peripheral Nerve Repair

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Abstract

BACKGROUND: Peripheral nerve injuries often require surgical intervention to repair nerves. Autologous nerve grafting is a standard method for the repair of peripheral nerves. However, autologous nerve grafts have limitations such as restricted availability. Thus, the development of alternative strategies to address nerve defects is essential.

OBJECTIVES: This study aims to develop and prepare decellularized nerve scaffolds from ovine peripheral nerves and evaluate their histological features and mechanical properties for use in peripheral nerve repair.

METHODS: Brachial plexus nerves were isolated from male sheep cadavers under aseptic conditions and decellularized using detergent agents according to a decellularization protocol. The decellularization process was assessed using hematoxylin-eosin staining (H&E), Masson's trichrome staining method, and electron microscopy. The resistance and mechanical properties of the extracellular matrix structure were examined by tensile testing. The DNA content of decellularized nerves and intact nerves was also measured using a kit and NanoDrop.

RESULTS: The evaluations showed that cells were completely removed from the nerve scaffolds, and the extracellular matrix was well preserved in the nerve scaffold. Tensile testing revealed that decellularized nerve scaffolds relatively maintained their mechanical properties compared to control nerves. Examining the DNA content of scaffolds and intact nerves also showed that the DNA content of nerves was significantly reduced after the decellularization process.

CONCLUSIONS: The prepared decellularized peripheral nerve grafts can preserve extracellular matrix components. The decellularized nerve scaffolds have the potential to be alternatives to artificial nerve conduits and autografts for peripheral nerve repair.

Keywords: Decellularization, Extracellular matrix, Nerve graft, Peripheral nerve, Tissue engineering

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Figure Legends and Table Captions

Figure 1. Images of the longitudinal and transverse sections of decellularized nerve (A,B) and intact nerve (C,D) in sheep (H&E × 200). Arrows indicate the nucleus of the cells.
Figure 2. Light microscopic image of the longitudinal section of decellularized nerves (Alcian blue staining ×100).
Figure 3. Light microscopic image of the transverse section of the decellularized nerve (Masson's trichrome staining ×100).
Figure 4. Scanning electron microscopic images of the longitudinal section of intact nerve (A), and decellularized nerve (B) in sheep.
Figure 5. Comparison of tensile test results for intact and decellularized nerves.
Figure 6. Comparison of DNA content between intact and decellularized nerves.