

Potential Effect of Imeglimin on Mitochondrial Function in Subsynovial Connective Tissue of Idiopathic Carpal Tunnel Syndrome

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Disclosures:

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INTRODUCTION:

Patients with idiopathic carpal tunnel syndrome (CTS) exhibit impaired mitochondrial function in the subsynovial connective tissue (SSCT) of the carpal tunnel. We hypothesised that Imeglimin, a compound known to enhance mitochondrial function, may improve mitochondrial activity in SSCT from these patients. This study aimed to evaluate the effects of Imeglimin on mitochondrial function in SSCT-derived cells obtained from patients with idiopathic CTS.

METHODS:

SSCT samples were collected from 15 patients (mean age: 67.5 ± 9.7 years) who underwent carpal tunnel release surgery between April 2022 and March 2024. The cells were cultured under control conditions (Dulbecco's Modified Eagle Medium alone) or with 100 μM Imeglimin for 24 hours. Mitochondrial function was assessed using multiple assays, including cell proliferation, superoxide dismutase (SOD) activity, apoptosis rate, mitochondrial volume, membrane potential, reactive oxygen species (ROS) production, gene expression related to mitochondrial biogenesis and antioxidant capacity, mitochondrial permeability transition pore opening, and ultrastructure by transmission electron microscopy. Statistical analyses were performed using the Mann-Whitney U test, one-way ANOVA, Kruskal-Wallis test, and Fisher's protected least significant difference test, with $p < 0.05$ considered significant.

RESULTS SECTION:

Compared with the control group, the Imeglimin-treated group showed significantly increased cell proliferation, SOD activity, mitochondrial membrane potential, mitochondrial volume, cristae density, and expression of genes related to mitochondrial biogenesis and antioxidant defense. Apoptosis and mitochondrial ROS production were significantly reduced ($p < 0.05$).

DISCUSSION:

These findings suggest that Imeglimin may enhance mitochondrial function in SSCT-derived cells from patients with idiopathic CTS, offering a potential therapeutic strategy for mitochondrial dysfunction in CTS.

SIGNIFICANCE/CLINICAL RELEVANCE:

This study provided important information on the histological changes and potential therapeutic approaches regarding subsynovial connective tissue within the carpal tunnel in carpal tunnel syndrome.

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IMAGES AND TABLES:

Table 1. Patient Background Data.

Figure 1. Representative immunofluorescence images of the detection of nuclear fragmentation (suggestive of apoptosis) in cells incubated in the control and Imeglimin groups. The TUNEL staining (green) highlights the apoptotic cells in each group. The images were captured at 100× magnification, with a scale bar of 200 μm.

Figure 2. Representative TEM images of the SSCT-derived cells in the control and Imeglimin groups (Scale bar = 500 nm). Quantification of the mitochondrial area and the cristae number per 0.1 μm² mitochondria for 100 mitochondria (Control vs Imeglimin; $p < 0.05$). All values are expressed as mean, with the error bars indicating standard deviations. TEM, transmission electron microscopy; SSCT, subsynovial connective tissue

Table 1.

n	15
Age	67.5±9.7 (52-89)
Gender (male/female)	3/12
Right / Left	11/4
electrophysiological severity scale	Stage IV-8, V: 7

Figure 1.

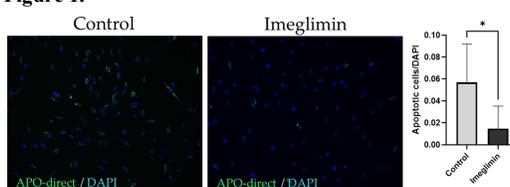


Figure 2.

