통증 및 근골격재활

발표일시 및 장소: 10 월 18 일(금) 14:25-14:35 Room A(5F)

OP1-2-2

Synergetic effects of polydeoxyribonucleotide with shock wave on rotator cuff tendon tear rabbit.

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Objective

To investigate the synergic therapeutic effects of polydeoxyribonucleotide (PDRN) combined with extracorporeal shock waves therapy (ESWT) and the effects according to ESWT sequences on a chronic traumatic full thickness rotator cuff tendon tear (FTRCTT) in a rabbit model.

Methods

Rabbits (n = 32) were allocated into 4 groups. After a 5-mm sized FTRCTT just proximal to the insertion site on the supraspinatus tendon was created by excision, the wound was immediately covered by silicone tube to prevent natural healing. After 6 weeks, 4 types of procedures (0.2 mL normal saline, group 1; 0.2mL PDRN injection, group 2; 0.2 mL PDRN injection before ESWT, group 3; and 0.2 mL PDRN injection after ESWT, group 4) were performed into FTRCTT under US guidance (Figure 1). Radial type of ESWT (1.5 bar, 3 Hz) was applied 4 times weekly. We evaluated gross morphologic changes on all rabbits after euthanize. Proliferating cell nuclear antigen (PCNA), vascular endothelial growth factor (VEGF) and platelet endothelial cell adhesion molecule (PECAM-1) stain were performed to evaluate histological changes. Motion analysis was also performed. We used chi-square test, analysis of variance (ANOVA) to determine statistical differences among intra- and inter-groups. When ANOVA yielded significant results indicating that the group was significantly different from others, tukey's post-hoc test was also performed. All data are expressed as mean ± standard deviation, and statistically significant levels were predetermined at $P < 0.05$.

Results

In gross morphology, mean tendon tear size in group 2, group 3, and group 4 was significantly smaller than that in group 1 ($p < .05$). In histochemical and motion analysis, PCNA, VEGF, PECAM-1 stained cells and walking distance, fast walking time, mean walking speed in group 2, group 3, and group 4 were greater than those in group 1 ($p < .05$). In group 4, all measured parameters showed significantly greater than those in group 2, and the three parameters such as PCNA, PECAM-1 stained cell, and fast walking time showed significantly greater than those in group 3 ($p < .05$) (Table 1). However, there were no significant differences in all parameters between group 2 and group 3.

Conclusions

These results demonstrated that ESWT before PDRN injection was more effective than saline, PDRN alone, and ESWT after PDRN in anigiogenesis on a chronic traumatic FTRCTT in a rabbit model. According to the results it was possible to propose, applying ESWT before PDRN injection may be the most appropriate treatment sequence.

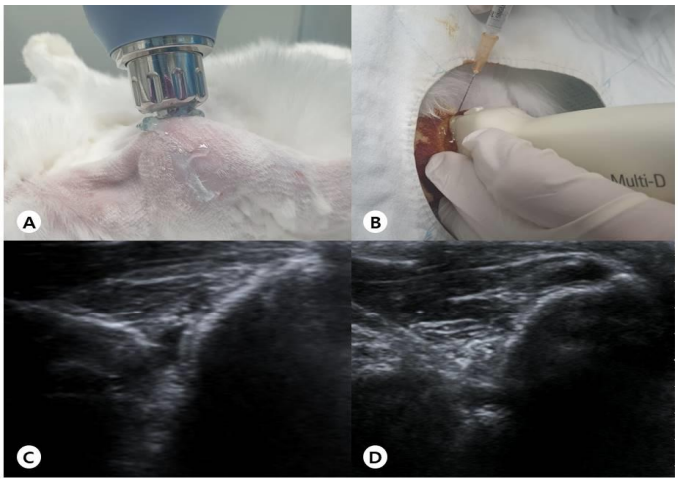

Figure 1. ESWT was performed (A) after (G3-PDRN+ESWT) or before (G4-ESWT+PDRN) 0.2 mL of PDRN injection (B) into FTRCTT under US guidance (C-D). Abbreviations are ESWT, Extracorporeal shockwave therapy; PDRN, Polydeoxyribonucleotide; US, Ultrasound

Table 1. Semiquantitative score of gross morphologic, histological findings, immunoreactivity of stain and motion analysis according to treatment groups at 4 weeks after first injection.

	Groups (Injection regimens)			
	G1-SAL (n=8)	G2-PDRN (n=8)	G3-PDRN+ESWT (n=8)	G4-ESWT+PDRN (n=8)
Gross				
Tear size	13.79±1.38	12.42±1.63*	11.71±1.24†	10.60±1.54‡ ‖
Histological score				
PCNA	1.25±1.05	2.53±0.95*	2.53±0.08†	2.88±0.10‡ ‖ ¶
VEGF	1.40±0.91	2.06±0.81*	2.13±0.12†	2.44±0.10‡ ‖
PECAM-1	1.71±0.85	2.24±0.70*	2.29+0.12†	2.64+0.10‡ ‖ ¶
Motion analysis				
Walking distance(cm)	4852.75±137.27	5514.38±257.25*	5779.00±301.9†	5994.38±239.90‡ ‖
Fast walking time(%)	5.62±1.42	7.97±0.82*	7.87±0.74†	9.22±0.69‡ ‖ ¶
Mean walking speed(cm/sec)	6.33±0.57	8.21±0.58*	9.35±1.27†	10.76±1.54‡ ‖

Values are mean±SD.

The proportion of positive cells of PCNA, VEGF, PECAM-1 was scored as 0 = no cells stained positive, 1 = between 1% and 10%, 2 = between 11% and 33%, 3 = between 34% and 66%, and 4 = between 67% and 100%.

PDRN, Polydeoxyribonucleotide; ESWT, Extracorporeal shockwave therapy; PCNA, proliferating cell nuclear antigen; VEGF, Vascular endothelial growth factor; PECAM-1, Platelet endothelial cell adhesion molecule.

*) $p < .05$ one-way ANOVA, Tukey's post hoc test among group 1 and 2.

†) $p < .05$ one-way ANOVA, Tukey's post hoc test among group 1 and 3.

‡) $p < .05$ one-way ANOVA, Tukey's post hoc test among group 1 and 4.

§) $p < .05$ one-way ANOVA, Tukey's post hoc test among group 2 and 3.

‖) $p < .05$ one-way ANOVA, Tukey's post hoc test among group 2 and 4.

¶) $p < .05$ one-way ANOVA, Tukey's post hoc test among group 3 and 4.

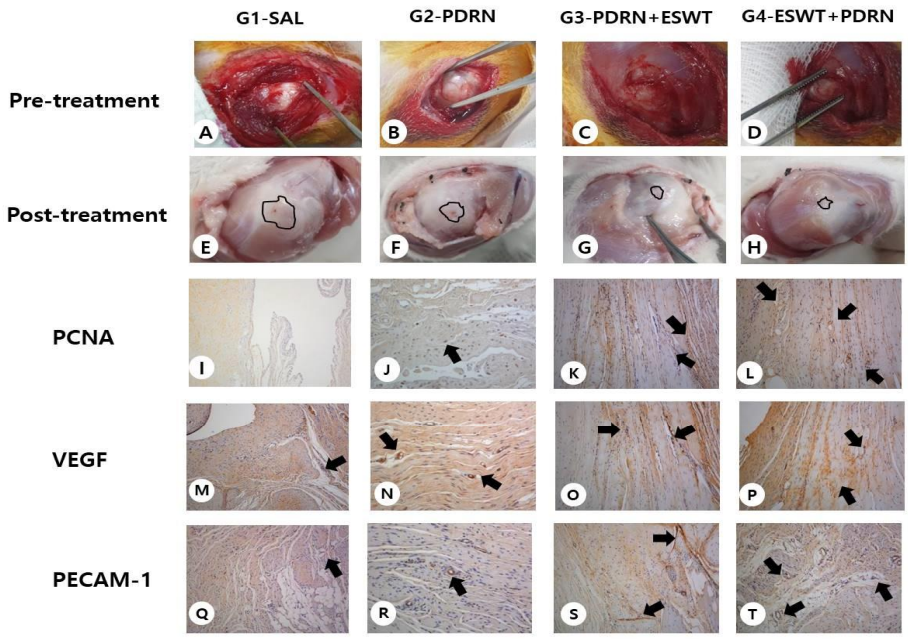

Figure 2. Gross morphology and Histologic findings of the supraspinatus tendon.

Gross morphological (A–H) findings of the supraspinatus tendons in G1-SAL, G2-PDRN, G3-PDRN+ESWT and G4-ESWT+PDRN. (A-D) Pre-treatment images; (E-H) Post-treatment images. Numerous cell proliferating PCNA stained cells (black arrow, x 100) were observed in regenerated tendon fibers in G4-ESWT+PDRN. Lesser PCNA stained cells were observed in G2-PDRN, G3-PDRN+ESWT and few PCNA stained cells were observed in G1-SAL (I to L). Numerous VEGF-positive cells and PECAM-1 positive microvascular angiogenesis densities (black arrows, x 100) were observed in G3-PDRN+ESWT, and G4-ESWT+PDRN. Fewer VEGF-positive cells and PECAM-1 positive microvascular angiogenesis densities were observed in G1-SAL, and G2-PDRN (M to T). In G4-ESWT+PDRN, PECAM-1 positive densities are significantly greater than those of G3-PDRN+ESWT.

Abbreviations are PDRN, polydeoxyribonucleotide; ESWT, Extracorporeal shockwave therapy; PCNA, proliferating cell nuclear antigen; VEGF, vascular endothelial growth factor; PECAM-1, Platelet endothelial cell adhesion molecule.