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Molecular indicators of isometric exercises efficacy in early rehabilitation of older adults following their total hip replacement

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INTRODUCTION & AIM

The development of isometric exercise (IE) protocols for the early rehabilitation of older adults following total hip replacement (THR) and molecular methods for assessing their efficacy was our aim.

METHOD

Eight female patients aged 73-77 years were randomized before a THR into two groups of four patients each.

During the first 12 days after the THR, the patients performed daily rehabilitation exercises following the standard protocol in the control group and following the standard protocol supplemented with a complex of IE in the experimental group. The clinical parameters of the blood, ESR, CRP, and the concentrations of certain pro-inflammatory interleukins in the blood were evaluated before the THR, as well as 1 day and 12 days after the THR, for each patient. At these times, rectus femoris biopsies of the operated limb were performed in each patient for a transcriptomic analysis.

RESULTS & DISCUSSION

The indicators of the clinical blood analysis, ESR, muscle injury, and CRP did not reveal any significant difference between the groups (Fig. 1). The concentrations of IL-6, IL-8, and IL-1b recovered to the normal range by 12 days after the THR in the experimental group but not in the control group (Fig. 2). The transcriptomic analysis of the muscle biopsies revealed significant up-regulation of the processes associated with inflammatory and immune responses as compared to that in the preoperative state in both groups at day 1 (Fig. 3) and in the control group by 12 days after the THR (Fig. 4), while there were no signs of such activation in the experimental group by 12 days after the THR.

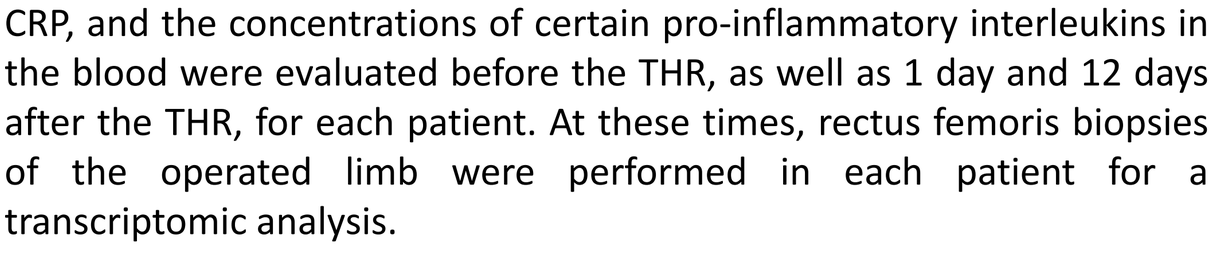

Figure 1. Total leukocyte concentration (A), neutrophil concentration (B), ESR (C), and C-RP concentration (D) of patients in the control and experimental rehabilitation groups 1 day before a THR (0), 1 day (1), and 12 days after the THR. The symbols indicate individual patient indicators. The dotted lines mark the upper and lower limits of the normal values of the measured indicators.

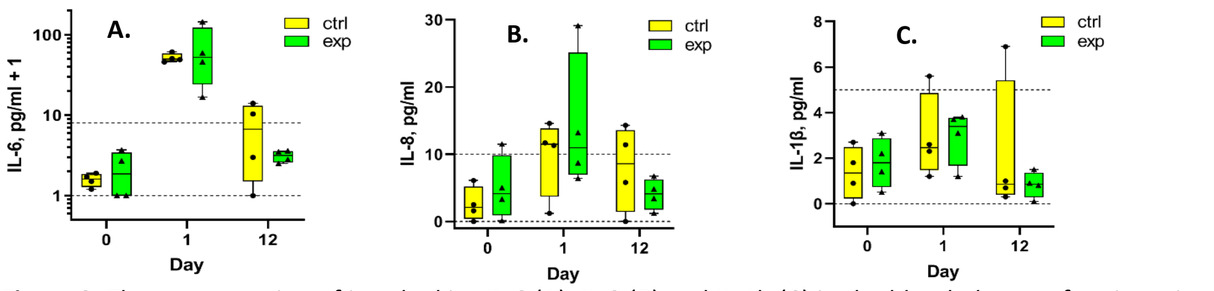

Figure 2. The concentration of interleukins IL-6 (A), IL-8 (B) and IL-1b (C) in the blood plasma of patients in the control and experimental rehabilitation groups 1 day before a THR (0), 1 day (1) and 12 days (12) after the THR. The symbols indicate individual patient indicators. The dotted lines mark the upper and lower limits of the normal values of the measured indicators.

Figure 3. Gene Set Enrichment Analyses (GSEA) dot plots show activation of the biological processes, molecular functions and signaling pathways associated with the immune response (A) and inflammation (B) in the muscle of the patients of the control and experimental groups in 1 day after the THR compared to 1 day before the surgery. NES – normalized enrichment score. The different databases used are highlighted with color. Dot diameter points to the percent of upregulated genes in a process/pathway.

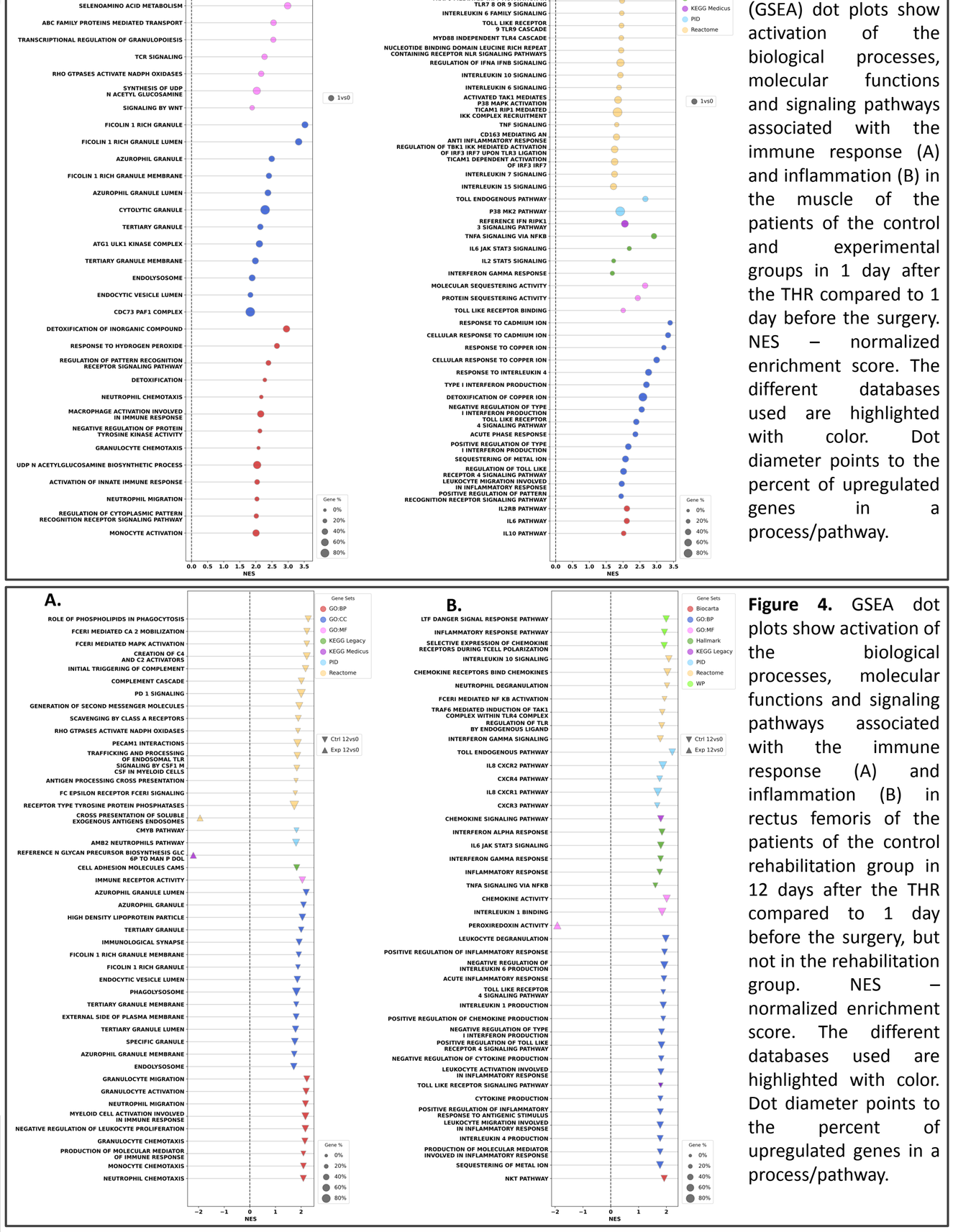

Figure 4. GSEA dot plots show activation of the biological processes, molecular functions and signaling pathways associated with the immune response (A) and inflammation (B) in rectus femoris of the patients of the control rehabilitation group in 12 days after the THR compared to 1 day before the surgery, but not in the rehabilitation group. NES – normalized enrichment score. The different databases used are highlighted with color. Dot diameter points to the percent of upregulated genes in a process/pathway.

CONCLUSION

The concentrations of IL-6 and IL-8 in the blood, as well as transcriptomic signatures of the processes and signaling pathways associated with inflammatory and immune responses, can be interpreted as molecular indicators of IE's efficacy for the early rehabilitation of older adults after a THR.

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