P-51

生命科学

Antibacterial properties of the human adipose mesenchymal stem cells-derived secretome and its protective effects at the cellular and tissue levels

TECHNOLOGY SHOWCASE

■ Introduction

Antimicrobial resistance (AMR) is critical global health issue that jeopardizes the success of surgeries, wound healing, cancer therapies, and other medical treatments. While antibiotics are the conventional treatment for infections, their indiscriminate use has led to an increase in bacterial resistance, limiting their effectiveness. This limitation underscores the need for alternative approaches, particularly for medically vulnerable populations. Adipose tissue derived cells, and its secreted factors are a promising candidate for tissue protection and infection control. Nevertheless, there is limited research regarding their antibacterial properties. Therefore, this study aimed to compare the antimicrobial properties of conditioned media (CM) derived from mesenchymal stem cells isolated from two subtypes of human white adipose tissue: subcutaneous (sAT-MSC) and omentum (oAT-MSC). In addition, the impact of the CM on the survival and functionality of human aortic endothelial cells and skin tissue wound regeneration during infection was examined.

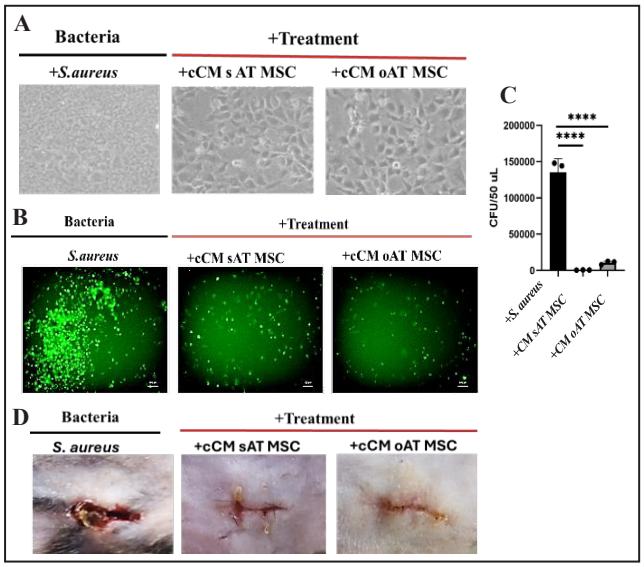
■ Activities performed

1. Functional assessment of CM derived from sAT-MSC and oAT-MSC

CM was harvested from the culture of sAT-MSC and oAT-MSC, then subjected to bacterial interaction assays to examine potential antimicrobial effects. Subsequently, co-culture systems with human aortic endothelial cells (HAEC) were established to evaluate oxidative stress (ROS levels), morphology, and functional activity. Finally, an in vivo skin infected mice model was used to investigate the regenerative and antibacterial effects of the CM.

2. Antibacterial, cellular and tissular protection of CM derived from sAT-MSC and oAT-MSC

Our results showed that CM derived from sAT-MSC and oAT-MSC exhibited antibacterial effect against the growth of *E.coli, S. aureus* and MRSA strain. In addition, CM derived from sAT-MSC and oAT-MSC effectively protected HAEC which maintain the morphology and tube formation capacity of these cells which is related to the reducing intracellular ROS following bacterial exposure (Figure 1A-C). Transcriptomic profile analysis of sAT-MSC and oAT-MSC revealed the presence of SERPINE1 and TIMP1 as secreted factors that may be involved in promoting cellular and tissue protection. Furthermore, CM derived from sAT-MSC and oAT-MSC promoted wound healing after live bacterial exposure in a in vivo skin infection mouse model (Figure 1D).



3. Discussion

The antibacterial and protective capacity of CM derived from sAT-MSC and oAT-MSC inhibits bacterial growth while maintaining cellular integrity, as well enhancing tissular recovery in vivo was demonstrated. These results suggest significant therapeutic potential in using derivates factors from sAT-MSC and oAT-MSC to prevent infections and preserve cellular function under pathological conditions in vitro as well as providing tissular protection in vivo. Therefore, mesenchymal stem cell-derived factors could potentially be an effective cell-free tool for infection control and for the improvement of clinical outcomes in surgeries.

■ 関連情報等(特許関係、施設)

This research was conducted by the Regenerative Medicine and Stem Cell Biology Research Group in conjunction with the Laboratory of Microbiology at the Institute of Medicine, University of Tsukuba, Tsukuba, Japan.

代表発表者 **Adeline Castro Ramos (アデリーネ・カストロ・ラモス)**
所　　属 **Tsukuba University, Graduate School Comprehensive Human Science, Laboratory of Regenerative Medicine and Stem Cell Biology**
問合せ先 **〒305-8575, Ibaraki, Tsukuba, Tennodai 1-1-1**
TEL:029-853-2938

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■共同研究者:
※ Cat-Khanh Vuong (Tsukuba University), Mizuho Fukushige(Tsukuba University), Kazuya Morikawa(Tsukuba University), Yuri Ushijima(Tsukuba University); Osamu Ohneda(Tsukuba University)