Case report: Effectiveness of umbilical cord mesenchymal stem cell-derived exosomes in reducing symptoms of a patient with atopic dermatitis on the face and neck

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Summary

A 44-year-old woman with a 10-year history of nummular eczema received antibiotics and anti-inflammatory treatment, improving her condition. This study monitored the changes in external signs of the facial and neck skin of a patient with atopic dermatitis (nummular eczema) after treatment with exosomes secreted from umbilical cord mesenchymal stem cells. The treated skin area was topically applied with exosomes combined with hyaluronic acid and electrophoresis to support exosome absorption into the inner skin layers, with three consecutive treatments over three weeks. Safety was monitored within 72 hours, and clinical symptoms were followed up to three months. Results showed that no adverse effects were recorded (such as hot sensation, redness due to irritation, burning, swelling, edema, or fever). Symptoms of atopic dermatitis were reduced immediately after the first treatment. After the third treatment, all monitored characteristics were significantly improved. Specifically, redness and itching decreased by two levels, dry skin decreased by one level, and skin brightness and smoothness increased by two levels. These data indicate that exosomes are safe and effective in reducing atopic dermatitis and increasing skin moisture, reducing dryness, redness, and itching on the face and neck.

Keywords: Atopic dermatitis, exosomes, safety, efficacy.

I. BACKGROUND

Atopic dermatitis (AD), also known as eczema, is a chronic (long-lasting) condition that causes the skin to become inflamed, itchy, dry, and irritated [1]. It's part of a group of allergic conditions known as atopy, which also includes asthma and hay fever [1]. Atopic dermatitis often starts in childhood but can develop at any age. It can range from mild to severe and tends to flare up periodically [1].

The disease is often inherited and is caused by an overactive immune response to certain triggers, leading to inflammation. Additionally, the dysfunction of the skin barrier is also a cause of the disease. In these cases, the skin's natural protective barrier is weakened in people with atopic dermatitis, making them more susceptible to irritants, allergens, and infections [1]. Finally, common triggers in the polluted environment, including pollen, pet dander, dust mites, smoke, certain soaps or detergents, extreme temperatures, and stress, contribute to the disease [1].

Atopic dermatitis tends to be a lifelong condition, but with proper treatment and care, most people can manage their symptoms effectively and experience periods of remission. The disease treatment approaches include topical treatments, moisturizers, antihistamines, immunosuppressive

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therapy, and avoiding triggers [1]. Recently, exosomes derived from adipose tissue-originated mesenchymal stem cells have been shown to be potentially effective for atopic dermatitis [2, 3]. This is due to exosomes have roles in modulate immunology, tissue regeneration, and moisturization [4].

Thus, we present a case study of a woman with atopic dermatitis (nummular eczema) who has been experiencing symptoms for 10 years and would like to use exosomes, as she is not confident about going outside and meeting other people due to the condition of her skin.

II. CASE

2.1. Case description

A woman patient aged 44 years old was diagnosed with nummular eczema (atopic dermatitis) for 10 years and has been treated with antibiotics and anti-inflammation drugs during the acute treatment and skin care. The patient is not confident in her appearance and is afraid to attend social events and meet other people. The patient has undergone acute treatment, and signs of nummular eczema and inflammation have been reduced.

Table 1. Patient characteristics

Characteristics	Description
Age	: 44
Gender	: Female
BMI	: 19.2
Diagnosis	: Nummular eczema (atopic dermatitis)
Duration (diagnosed - present)	: 10 years
Acute treatment	: Antibiotics, anti-inflammation drugs

At the time of the decision to use exosome treatment, the patient's facial and neck skin was dry, red, very sensitive, and itchy. Symptoms of atopic dermatitis were observed by the doctor, where the severity of symptoms was evaluated using a semi-quantitative grading scale: (–) none; (+) mild; (++) moderate; (+++) severe; (++++) very severe.

2.2. Exosome preparation

Umbilical cord-derived mesenchymal stem cells (UCMSCs) were expanded to passage 5 for exosome secretion. Then, conditioned media (on day 5 of cell cultures that contained exosomes) were harvested for exosome isolation using differential centrifugation. The centrifuge protocol has been developed by the EV group (Vinmec Hi-Tech Center) and published [5]. Following our protocol, exosomes expressed a sup-shaped morphology, size ranging from 50 - 250nm, and were positive with CD63. Additionally, UCMSC-derived exosomes used in this study contained growth factors and cytokines, including fibroblast growth factor (FGF), hepatocyte growth factor (HGF), keratinocyte growth factor (KGF), vascular endothelial growth factor (VEGF-A), platelet-derived growth factor (PDGF-BB), interleukin 6 (IL-6), IL-7, and IL-8 [6]. Exosome pellets were resuspended in phosphate buffer saline (PBS) to a final concentration of 900 µg total protein / 2mL and frozen for further use. Peptidyl 115, which contains hyaluronic acid (15 mg/mL), was purchased from a supplier (Aerazen Lab, Switzerland) and divided into 2 mL per single use. Both exosome products and peptidyl 115 (hyaluronic acid) are sterilized products.

Expansion of UCMSCs for exosome secretion and exosome isolation was performed at Vinmec Hi-Tech Center. Additionally, the patient's treatment was performed at Vinmec View Times City.

2.3. Intervention and management

The face and neck were cleaned using the facial cleanser as per the patient's routine before being dried using soft tissue. Next, exosome products were thawed and topically applied on the skin surface, and then electroporation (NDvita Ocean, Korea) was used with a current intensity of 0.6mA for six to eight minutes to support the absorption of exosomes into the skin. Next, peptidyal 115 solution (2mL) was applied topically with a similar electroporation for five minutes. After that, the

patient was sprayed with mineral water every hour for six to 10 hours after treatment. The patient underwent three interventions/three weeks.

Safety characteristics were evaluated during and after the treatment for 72 hours by observation. These included characteristics of fever, swelling, inflammation, pain, and irritation-related redness. The doctor observed and interviewed the patient during the following.

Signs associated with the treatment of exosomes were followed, including levels of red skin, itch, skin moisture (feeling of dry skin), smoothness, and brightness up to three months.

III. RESULT

The safety of using esosomes

Table 2 describes the appearance frequency of safety signs during and after exosome treatment. All safety signs were followed and analyzed, including fever, swelling, inflammation, pain, and irritation-related redness, but were not recorded. This indicates that exosomes are safe for the skin.

Table 2. Safety analysis

Order	Symptoms	Appearance	Note
1	Fever	No	
2	Swelling	No	
3	Inflammation	No	
4	Pain	No	
5	Irritation-related redness	No	

Efficacy of exosomes in atopic dermatitis treatment

Table 3 describes the levels of change in the variables used to evaluate the efficacy of exosomes in the treatment of atopic dermatitis.

Table 3. Changes in variables associated with exosome treatment

Order	Symptoms	Level		Note
		Before treatment	After three treatments	
1	Red-skin	+++ (Redness appeared along the skin's vascular branches)	+ (Reducing significantly the redness)	
2	Itchy	+++ (Easily itchy)	+(Reducing significantly)	
3	Skin moisture (felling dry skin)	++++ (Very dry, feeling always want to dip face in water, spraying mineral water continuously)	++ (More comfortable, reducing frequency of spraying mineral water)	
4	Smoothness	+	+++	
5	Brightness	+	+++	

Note: -: No; +: mild; ++: Medium; +++: Severe; ++++: Very severe.

Patient self-assessment showed a reduction in feelings of tension, stinging, and dryness immediately after exosome application. These feelings extended for seven days till the subsequent treatment. Additionally, the patient observed and felt skin becoming smooth and bright after 24 hours of treatment. She can go outside for up to five to seven hours compared to two hours before the treatment. The patient reported being happier at the end of the treatment (Figure 1).

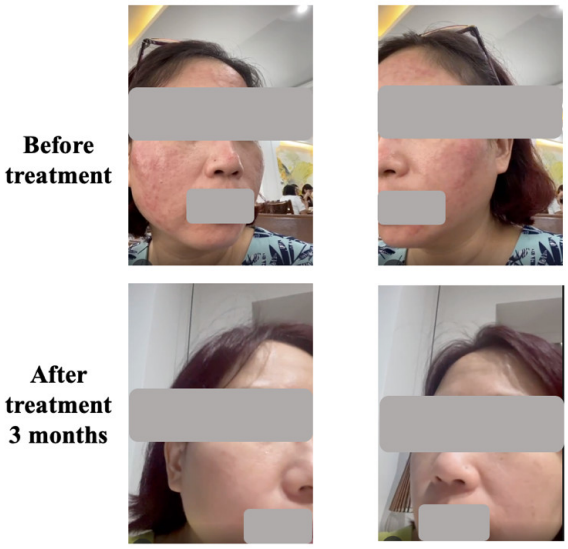

Figure 1. Patient with atopic dermatitis at the time of before and after three treatments.

IV. DISCUSSION

Exosomes are small vesicles released by cells that contain proteins, lipids, and nucleic acids. They can play a key role in cell communication, and their use in treating atopic dermatitis suggests they may help regulate immune responses and promote healing [7]. These days, exosomes are used for skin rejuvenation due to their ability to stimulate skin cell proliferation, migration, and ECM protein secretion [8, 9]. Consequently, these lead to a reduction in the signs of skin aging [10]. In this current study, exosomes derived from UCMSCs have effectiveness in reducing signs known as consequences of atopic dermatitis and increasing skin health conditions. This may be due to exosomes having potential for immunomodulation, which supports a reduction of inflammation, itch, and sensitivity. Additionally, our previous investigations showed that exosomes are enriched in growth factors; thus, exosomes could promote skin cell function, leading to smoother and brighter skin. These effects are also similar to those reported in previous investigations by Lee et al. (2024) and Bea et al. (2021) [11, 12].

The immediate improvement of atopic dermatitis symptoms after the first treatment is promising. The fast response could suggest that exosomes might help reduce inflammation or modulate immune responses quickly. By the third treatment, there's a notable reduction in symptoms, pointing to the cumulative benefit of the exosome therapy. This gradual improvement suggests the therapy is working at a deeper level, possibly through mechanisms like cell regeneration, tissue repair, or immune modulation. Previously, Cho *et al.* (2018) and Shin *et al.* (2020) reported exosomes derived from human adipose tissue-derived mesenchymal stem cells to alleviate atopic dermatitis [2]. These are due to exosomes, which could reduce levels of IgE, eosinophils, inflammatory cytokines (such as IL-4, IL-5, IL-13, IL-23, IL-31, IFN-γ, IL-17, and TNF-α), thymic stromal lymphopoietin (TSLP), and transepidermal water loss, while also improving stratum corneum moisture [2, 3].

This report paints a very positive picture of exosome therapy for atopic dermatitis. There were no side effects, and the significant improvement in symptoms and skin health is encouraging, indicating that exosome therapy could be an effective treatment option for managing this chronic condition. Additionally, the patient is very happy with exosome therapy, which has increased her confidence. Despite the great results, this study has several limitations, including the tool used to evaluate disease levels and the confounding factor. We have recorded the disease based on the observation using a tool developed by the medical doctor, but not using any validated scoring system, such as SCORing Atopic Dermatitis (SCORAD), Eczema Area and Severity Index (EASI), or Investigator's Global Assessment (IGA). This leads to scientific limitations and difficulties in comparison with other reports. Moreover, in this study, we used a combination of hyaluronic acid and exosomes with electroporation support, suggesting that hyaluronic acid could improve skin condition by reducing dryness, which could be considered a confounding factor. Previous studies have shown that exosomes (from bovine milk) preserve skin moisture [13]; thus, the reduction in skin dryness could be a synergistic effect of hyaluronic acid and exosomes.

Despite exosomes having been reported for cutaneous wound healing and rejuvenation, this is a pilot and case report on their role in atopic

dermatitis. This means that further research and clinical studies would be necessary to fully understand the long-term benefits and mechanisms involved.

V. CONCLUSION

The data collected from this case indicate that exosome treatment appears to be a safe and effective therapy for managing symptoms of atopic dermatitis, with both immediate and lasting benefits observed in this patient. This proposes a new candidate for the treatment of atopic dermatitis and is important for the future application of exosomes. However, this is only a case study; thus, further research and clinical studies are required to confirm these findings and evaluate the long-term efficacy of exosomes in treating skin conditions such as atopic dermatitis.

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