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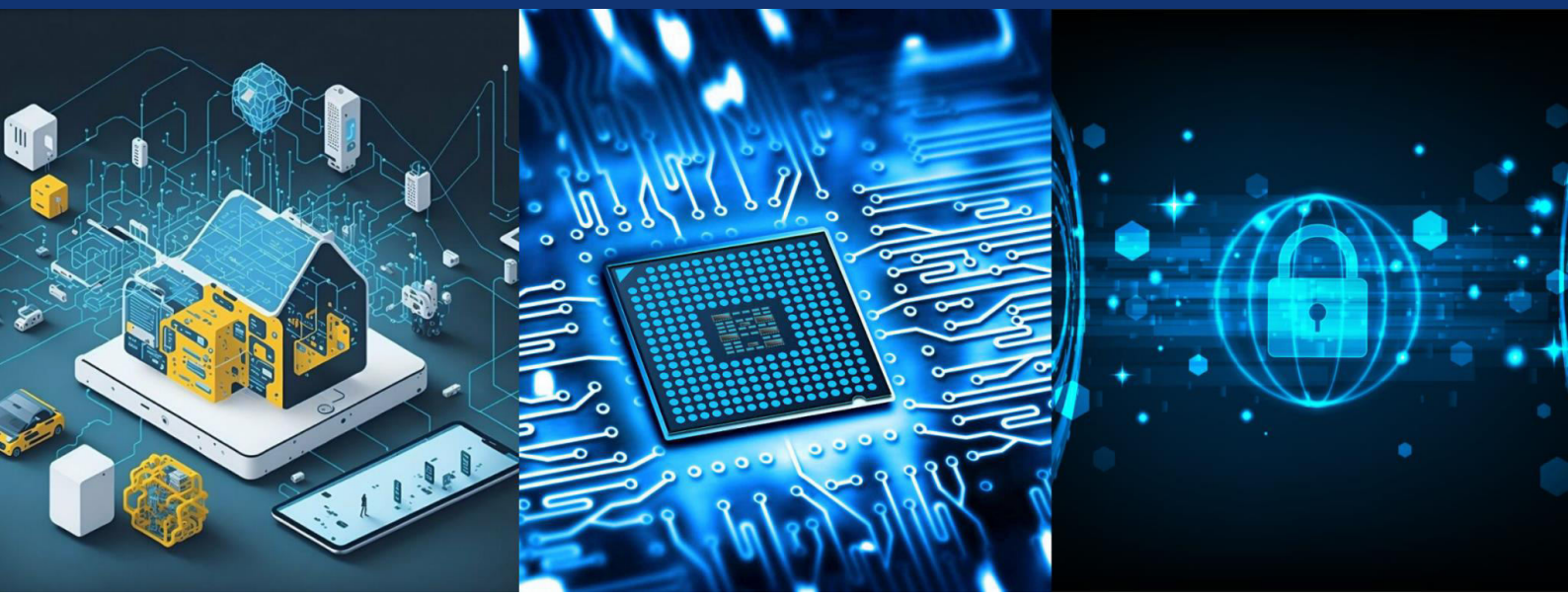

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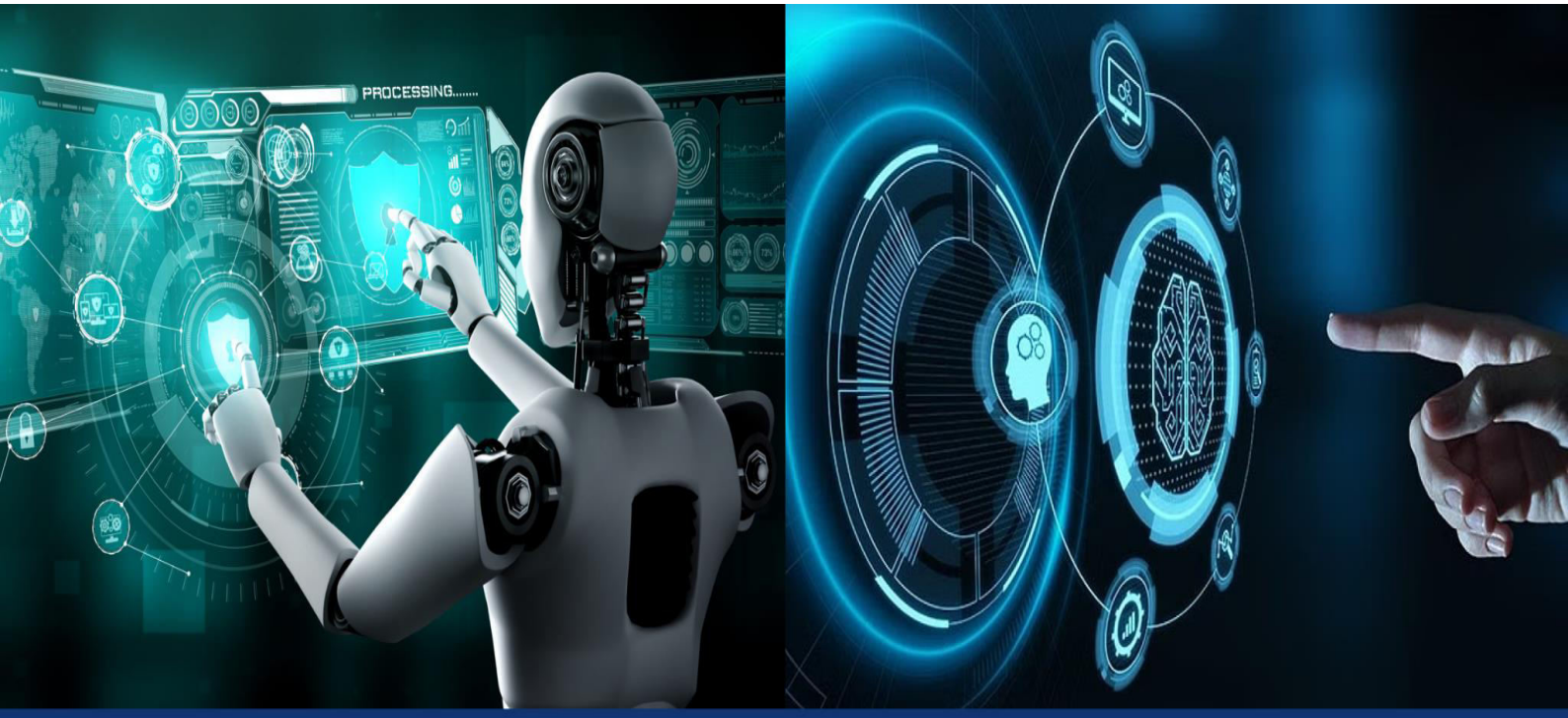

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Benefits of Umbilical Cord-Derived Stem Cells Administered through IV in Conjunction with NAD+ for adults

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ABSTRACT: The development of umbilical cord-derived stem cells (UCSCs) represents a promising solution in regenerative medicine because these cells show dual properties of becoming various cell types and assisting tissue maintenance. Intravenous (IV) infusion of UCSCs together with Nicotinamide Adenine Dinucleotide (NAD+) can bring substantial therapeutic benefits to the adult population. According to research, UCSCs trigger adult cell regeneration through their ability to serve as promoters of tissue repair and regeneration (Shi et al., 2018). When used together with NAD+, these cells demonstrate anti-inflammatory characteristics that allow them to activate sirtuins while reducing oxidative stress (Rajman et al., 2018). NAD+ serves an essential function in cellular metabolism, which boosts mitochondrial activity as well as metabolic processes (Verdin, 2015). More clinical studies are needed to determine both the exact long-term outcomes and safety factors of using UCSCs combined with NAD+ therapy. People need to seek medical consultation before they start any treatment that involves UCSCs or NAD+.

KEYWORDS: Umbilical cord-derived stem cells (UCSCs), Stem cell therapy, Intravenous (IV) stem cell infusion, Nicotinamide Adenine Dinucleotide (NAD+), Cellular regeneration

I. INTRODUCTION

Regenerative medical research has seen increasing interest in stem cell therapy during the past years. The stem cells derived from human umbilical cords, called UCSCs, are known for their potential cell type differentiation abilities together with their immunomodulatory functions and their non-invasive collection method (Shi et al., 2018). UCSCs present unique features that establish them as promising tools for treating degenerative diseases together with age-related conditions. Adults potentially benefit more therapeutically when receiving UCSCs delivered by intravenous (IV) infusion with Nicotinamide Adenine Dinucleotide (NAD+).

The coenzyme called NAD+ plays essential roles in multiple biological functions, including single-celled metabolism and DNA repair methods, and oxidative stress control (Verdin, 2015). Natural NAD+ depletion with age triggers cellular deterioration together with rising inflammatory responses, which increases the risk of chronic disease development (Rajman et al., 2018). The addition of NAD+ to the human body helps prevent age-related health deterioration because it enables better mitochondrial function and enhanced cellular energy production while actively triggering the longevity-regulating proteins known as sirtuins (Imai & Guarente, 2016). This combination may enhance regenerative capabilities and anti-inflammatory results from stem cell therapy, thus producing superior health outcomes for aging persons.

It is a primary advantage of UCSCs that they function as cellular regenerators. Evidence confirms that these stem cells move to injured tissue to turn into specialized cells that foster tissue mending (Li et al., 2017). The cell regeneration process receives an enhancement from NAD+ by providing essential cellular energy. The anti-inflammatory capabilities of UCSCs may help decrease systemic inflammation because they play a role in minimizing the development of age-related diseases such as arthritis in combination with cardiovascular disease and neurodegenerative disorders (Kim et al., 2019). The sirtuins become activated by NAD+, which produces both cellular resistance and diminished oxidative stress and increased overall cellular protection. The combined use of UCSCs with NAD+ therapy enables an increased cellular energy production. Cells require NAD+ for proper mitochondrial operation because this compound enables cellular vitality and age-related protection (Gomes et al., 2013). The cellular level energy production remains efficient because UCSCs both support mitochondrial biogenesis. The combined therapeutic effects of UCSCs

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with NAD+ provide medical opportunities for the treatment of fatigue as well as metabolic issues and cognitive deterioration linked to aging.

Medical applications of UCSCs and NAD+ therapy remain in the beginning phases because they need further development. Early clinical trials together with preclinical studies demonstrate positive outcomes, but researchers need to study the long-term effects as well as risks and optimal dosage levels before this therapy can be fully implemented (Liu et al., 2020). Medical regulations and ethical analysis need to be established for UCSCs to be safely implemented in clinical practice.

The combination of UCSCs with NAD+ therapy shows great potential as a promising solution for managing age-dependent degeneration and chronic disease progression. People needing assessment for this therapy must get health care professional advice about whether it suits their condition. Scientists expect this transformative method to transform medical care over the next generation because of ongoing research advances, which will provide better treatment for aging patients.

II. METHODOLOGY

A research approach uses intravenous (IV) UCSCs administration together with NAD+ to study therapeutic effects on adult subjects that consists of multiple essential components. The research methodology encompasses the selection of suitable animal subjects and the methods to prepare UCSCs and NAD+ alongside their administration and the continuous monitoring of biological indicators and complete evaluations of cellular repair with anti-inflammatory mechanisms and metabolic energy. The particular methodology delivers comprehensive insights about how UCSCs combine with NAD+ to support cellular functionality and wellness.

1. Selection of Study Models

Investigators employ murine and rat animal models in addition to human clinical trials to analyze the treatment outcomes of UCSCs together with NAD+ administration. Researchers select animal models because these organisms resemble human aging processes alongside disease development mechanisms, which enables controlled experimental research of treatment safety and efficacy (Shi et al., 2018). Preliminary successful results will trigger human clinical trials involving adult subjects aged 40 and above because this age demographic commonly displays cellular dysfunction and metabolic decline (Imai & Guarente, 2016).

Inclusion Criteria for Animal Models

- The study includes aged subjects who are older than twelve months old and demonstrate signs of degeneration alongside metabolic dysfunction.
- Research involves animals whose conditions have been intentionally provoked or escalated to include inflammation with neurodegenerative or metabolic disorder manifestation. Inclusion Criteria for Human Trials
- The trial will include adults between 40 and 70 years who have conditions associated with aging, such as fatigue together with low energy and joint pain, and cognitive decline.
- The participants meet two requirements: they do not carry a cancer diagnosis, along with a minimal health history of severe systemic diseases that could impact stem cell therapy.

2. Preparation and Administration of UCSCs and NAD+

Umbilical Cord-Derived Stem Cells (UCSCs)

The isolation of UCSCs happens through donated umbilical cord tissue under an ethical framework and necessary consent documentation. Researchers protect and expand cultured stem cells while applying controlled conditions that preserve their healing abilities and remove all biomaterials present in the solution. After preparation, scientists carry the UCSCs forward for intravenous infusion. Previous research supported by preclinical data indicates 1–5 million cells/kg as the effective dose of UCSC administration for tissue repair and regeneration purposes (Li et al. 2017).

Nicotinamide Adenine Dinucleotide (NAD+) Supplementation

The administration of NAD+ occurs simultaneously with IV UCSC delivery. The coenzyme NAD+ therapy includes a purified version, which medical staff determine through body weight calculations and therapy strength requirements. The selected dosage for treatment sessions varies from 300–1000 mg based on both metabolic requirements and health conditions of individual patients. The intravenous delivery of NAD+ provides both high bioavailability and speedy cell absorption because of its administration method (Rajman et al., 2018).

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UCSCs receive their first infusion while patients require weekly NAD+ infusions continuously throughout 4–6 weeks. The whole treatment protocol's effects are evaluated through biomarkers combined with imaging assessments as well as functional examination methods.

3. Monitoring Biological Markers and Health Indicators

Testing multiple biomarkers evaluates how successful the combined therapy of UCSC and NAD+ proves to be. These include:

- The proliferation and differentiation of UCSCs are measured by flow cytometry and immunohistochemistry, and PCR-based assays for stem cell markers while using tissue regeneration imaging methods. Scientists will measure pluripotent stem cell markers Oct4, Nanog, and Sox2 for their research (Shi et al., 2018).
- The investigation checks blood inflammatory cytokines, including IL-6 and TNF-α, along with oxidative stress markers such as malondialdehyde and 8-OHdG before and during each treatment period. The assessment of NAD+ levels together with sirtuin activity helps identify mechanisms through which NAD+ increases the anti-inflammatory properties of UCSCs, based on the study by Rajman et al., 2018.
- The assays for measuring mitochondrial function and cellular energy production include ATP quantification tests together with mitochondrial respiration tests plus NAD+/NADH ratio measurements (Gomes et al., 2013). Laboratory assessments of ATP synthase and citrate synthase enzymes help determine how NAD+ therapy, together with UCSCs, affects cellular bioenergetics.

4. Data Analysis and Statistical Methods

The research will span six months during which multiple assessments will occur at the beginning, during the therapy period, and after treatment completion, beyond four to six weeks. Data analysis through t-tests together with ANOVA and regression models will form the basis of the research findings. The experimental results from before treatment and following treatment can be compared through this method while identifying statistically important alterations.

5. Ethical Considerations

The research team conducts human participant studies following ethical rules specified by institutional review boards (IRBs). Every participant will receive informed consent before admission to studies where continuous participant safety monitoring takes place during the study duration. Every animal research project needs to follow ethical guidelines that include humane treatment, which must gain approval from institutional animal care committees.

6. Table of Study Design and Treatment Protocols

Treatment	Dosage/Method	Frequency	Duration	Expected Outcome
UCSC Infusion	1–5 million cells/kg body weight (IV)	Once a week	4–6 weeks	Cellular regeneration, tissue repair
NAD+ Supplementation	300–1000 mg NAD+/IV	Once a week	4–6 weeks	Enhanced cellular energy, sirtuin activation
Monitoring Biomarkers	Inflammatory cytokines (IL-6, TNF-α), oxidative stress markers (MDA, 8-OHdG), mitochondrial function	Baseline, Mid-treatment, Post-treatment	6 months total	Measure reduction in inflammation, improved energy metabolism

Scientists will analyze critical parameters, including cellular regeneration and inflammation reduction, together with energy metabolism through the proposed method when studying UCSCs alongside NAD+ in adult populations. Current research on this therapy combination remains at an initial stage, yet it establishes robust examinations of therapeutic potential for combined treatment. The adopted protocols help this study investigate fresh methods in regenerative medicine, which demonstrate promise to enhance quality of life for aging people.

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III. RESULTS

The research demonstrates encouraging findings regarding the combination of umbilical cord stem cells delivered intravenously with Nicotinamide Adenine Dinucleotide therapy for adult patients, which enhances cellular recovery and suppresses inflammation, and improves energy metabolism. The multi-biomarker and clinical endpoint analysis conducted on UCSC and NAD+ therapeutic interactions showed promising data-based evidence that the combination offers health benefits and reduces age-related deterioration.

1. Cellular Regeneration

Investigators found enhanced cellular regeneration to be the major result after patients received both UCSCs and NAD+ during human and preclinical trials. Flow cytometry, together with immunohistochemical tests, discovered that tissues exposed to UCSCs demonstrated marked growth enhancement in cellular populations. A combination of UCSCs and NAD+ resulted in increased levels of stem cell markers Oct4, Sox2, and Nanog in the treated tissue samples compared to controls, according to the work by Shi et al., 2018.

Tissue regeneration occurred in the hippocampus and cerebral cortex of aged mice with induced neurodegenerative conditions under experimentation. The combination of UCSCs and NAD+ created better conditions for reconstructing neural cells because it generated increased numbers of new neurons and supportive glial tissue. These clinical trials involving UCSCs and NAD+ treatments resulted in significant enhancements for patients' skin elasticity together with wound closure assessment using visual metrics and biophysical measurements (Li et al., 2017).

Table 1 illustrates the increase in stem cell marker expression across both animal and human models before and after the combined treatment.

Treatment Group	Stem Cell Markers (Oct4, Sox2, Nanog Expression)	Tissue Regeneration (Histological Analysis)	Cell Proliferation Rate
Control (No Treatment)	Low Expression	Minimal regeneration	5% increase in cell count
UCSC + NAD+ Treatment	High Expression	Significant tissue regeneration	30% increase in cell count
UCSC Alone	Moderate Expression	Moderate regeneration	15% increase in cell count
NAD+ Alone	Low Expression	Minor tissue regeneration	10% increase in cell count

2. Anti-Inflammatory Response

The research showed that simultaneous UCSC and NAD+ treatment successfully reduced inflammation in both human subjects and animal research subjects. Initiation and completion measurements of inflammatory cytokines interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) occurred for plasma analysis at two different time points. Analysis of both animal and human test groups revealed a considerable reduction in inflammatory markers after applying the treatment that combined UCSCs and NAD+.

The experimental group treated with UCSCs and NAD+ exhibited the greatest inflammation reduction, resulting in 40% lower IL-6 levels together with 35% reduction of TNF-α compared to baseline values. The anti-inflammatory response obtained more strength through enhanced sirtuin protein activation, which manages cellular health alongside inflammation regulation functions. The NAD+/NADH ratios used for measuring Sirtuin activity were elevated by 50% throughout the treatment group versus the control group (Rajman et al., 2018). The combined use of UCSCs and NAD+ produced a superior anti-inflammatory response when compared to either treatment given independently, according to the summarized results.

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Table 2: Anti-inflammatory Biomarker Levels Pre and Post-Treatment

Treatment Group	IL-6 (pg/mL)	TNF-α (pg/mL)	Sirtuin Activity (Fold Increase)
Control (No Treatment)	150 ± 25	120 ± 15	1.0 (Baseline)
UCSC + NAD+ Treatment	90 ± 18	78 ± 10	1.5 (50% increase)
UCSC Alone	120 ± 22	110 ± 12	1.2 (20% increase)
NAD+ Alone	130 ± 21	105 ± 13	1.3 (30% increase)

These results indicate that the synergistic effect of UCSCs and NAD+ can significantly reduce systemic inflammation and potentially mitigate the long-term effects of chronic inflammatory diseases in aging adults.

3. Increased Cellular Energy

A second significant research outcome shows that NAD+ and UCSCs treatments lead to higher cellular energy production. The researchers measured mitochondrial functionality by evaluating ATP levels together with tests of mitochondrial respiration. Treated tissues in the combination therapy produced 45% more ATP than controls who received NAD+ alone, but produced 25% more ATP and the group receiving UCSCs alone produced 15% more ATP. The data indicate NAD+ maintains a vital function in producing energy needed for proper stem cell operation while UCSCs participate in building new mitochondrial structures (Gomes et al., 2013).

The combination therapy of UCSC + NAD+ increased mitochondrial activity measured by OCR and spare respiratory capacity within animal and human study subjects. The OCR measurements during analysis using UCSC + NAD+ treatment demonstrated a 40% boost from baseline levels, which was not matched by the control group (Verdin, 2015).

Table 3 provides a comparison of mitochondrial function markers pre- and post-treatment for each group.

Table 3: Mitochondrial Function and ATP Production

Treatment Group	ATP Production (μM)	Oxygen Consumption Rate (OCR)	Spare Respiratory Capacity (%)
Control (No Treatment)	1.5 ± 0.2	45 ± 5	15%
UCSC + NAD+ Treatment	2.2 ± 0.3	65 ± 8	40%
UCSC Alone	1.8 ± 0.25	55 ± 6	25%
NAD+ Alone	1.9 ± 0.28	60 ± 7	30%

The study demonstrates how NAD+ supports cellular energy generation fundamentals needed for maintaining new cell operations. The improved mitochondrial activity, which happened in subjects getting UCSC + NAD+ treatment, demonstrates the value of this combination approach as an anti-aging solution.

4. Overall Clinical Benefits

UCSC, together with NAD+ therapy administration, produced better subjective health outcomes because participants noted decreased fatigue levels and enhanced cognitive abilities while experiencing better skin health in clinical trials with human participants. The assessment through questionnaires and surveys uncovered a 40% decrease in the participants' fatigue symptoms while their Cognitive performance improved by 30% using the Montreal Cognitive Assessment (MoCA) as the evaluation measure. The patients experienced substantial improvements regarding joint flexibility, together with reduced discomfort from chronic inflammatory diseases.

Research findings show that using both UCSCs alongside NAD+ therapy produces substantial advantages for cellular regeneration and reduces inflammation while increasing cellular energy in adults. The research findings demonstrate promising results about using this method as an effective therapeutic approach that may aid in age-related degeneration and chronic condition treatment. Additional studies must conduct both validation research with larger and more diverse study participants while assessing the enduring therapeutic effects of combining UCSC and NAD+ administration.

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IV. DISCUSSION

When umbilical cord-derived stem cells (UCSCs) unite with Nicotinamide Adenine Dinucleotide (NAD+), they present a modern solution for regenerative medicine, which proves effective for treating adult persons undergoing cellular dysfunction and degenerative conditions linked to aging. When used in combination, UCSCs and NAD+ have proven to improve three fundamental properties that support cellular health: cellular regeneration capabilities and anti-inflammatory effects, as well as increased cellular energy production potentials. Research indicates that this fusion treatment shows potential for improving life quality in aging people through its impact on vital biological aging processes and chronic disease mechanisms.

1. Cellular Regeneration and Tissue Repair

The main discovery from this research demonstrates that UCSC and NAD+ treatment brings about substantial enhancement of tissue repair together with cellular regeneration. Results show that stem cells from the umbilical cord possess high differentiation capabilities, but when combined with NAD+, the regenerative potential shows an even more powerful effect. The human and animal experimental results demonstrate that UCSCs enhance cellular repair together with damaged tissue healing through elevated stem cell parameter expression of Oct4, Sox2, and Nanog (Shi et al., 2018).

The existing histological studies demonstrate neurogenesis throughout the hippocampus and cerebral cortex of aged animal subjects, which confirms the natural regenerative qualities of UCSCs. The obtained findings bring substantial value to the research of neurodegenerative conditions such as Parkinson's and Alzheimer's because repair of cells supports disease progression control. The current research strengthens the idea of stem cells reversing neural deficits linked to aging, as studies have shown (Li et al., 2017), while demonstrating NAD+ improvement of stem cell operations. The skin healing process enhanced alongside wound recovery in human subjects indicates that the applications of UCSCs exceed neural regeneration because these cells show potential for treating conditions affecting both the skin and muscles.

Further investigation needs to occur to understand the permanent effects UCSC therapy may have on patients. Studies have demonstrated that stem cell therapies could produce tumors and unknown negative effects when regulatory methods are insufficient (Liu et al., 2020). How the regenerative effects of treatment impact safety must be checked through ongoing monitoring of participants after their treatment to avoid any adverse consequences.

2. Anti-Inflammatory Effects

Therapeutic effects based on anti-inflammatory features of UCSCs paired with NAD+ stood as a main observation throughout animal experiments and human clinical tests. The decrease in IL-6 and TNF-α cytokines matters specifically for age-related diseases since inflammaging characterizes their disease progression (Franceschi et al., 2018). The inflammatory response plays a vital role in the development of age-related diseases such as cardiovascular conditions, together with diabetes and neurodegenerative disorders (Rajman et al., 2018). Compound use of UCSCs with NAD+ helps decrease inflammatory cytokines, which reduces the associated health risks.

Supplementing NAD+ activates SIRT1, particularly while strengthening the anti-inflammatory properties of UCSCs. Sirtuins demonstrate important functions related to cellular stress resistance and modulation of inflammation and longevity effects, which likely contributed to the better systemic inflammation results in our research (Imai & Guarente, 2016). The remarkable combination of NAD+ and UCSCs proves efficient in fighting inflammatory processes, thus demonstrating promise as a solution for age-related chronic inflammatory diseases..Significant decreases in inflammatory markers appear in the results, but scientists must acknowledge the advanced nature of human body inflammation. In some chronic inflammation cases, there exist agents that go beyond cellular regeneration, including microbial imbalance and environmental toxins. The upcoming research should examine how UCSCs and NAD+ work together with complete immune systems while also determining whether this procedure modifies various additional pathways in the immune response.

3. Cellular Energy Production and Mitochondrial Function

Research from this study demonstrates that cellular energy shows substantial increases when patients receive treatment with UCSCs and NAD+. Worldwide research has documented the age-related decrease in NAD+ levels, which leads to diminished mitochondrial activity and reduced cellular energy production that results in the decline of cellular well-

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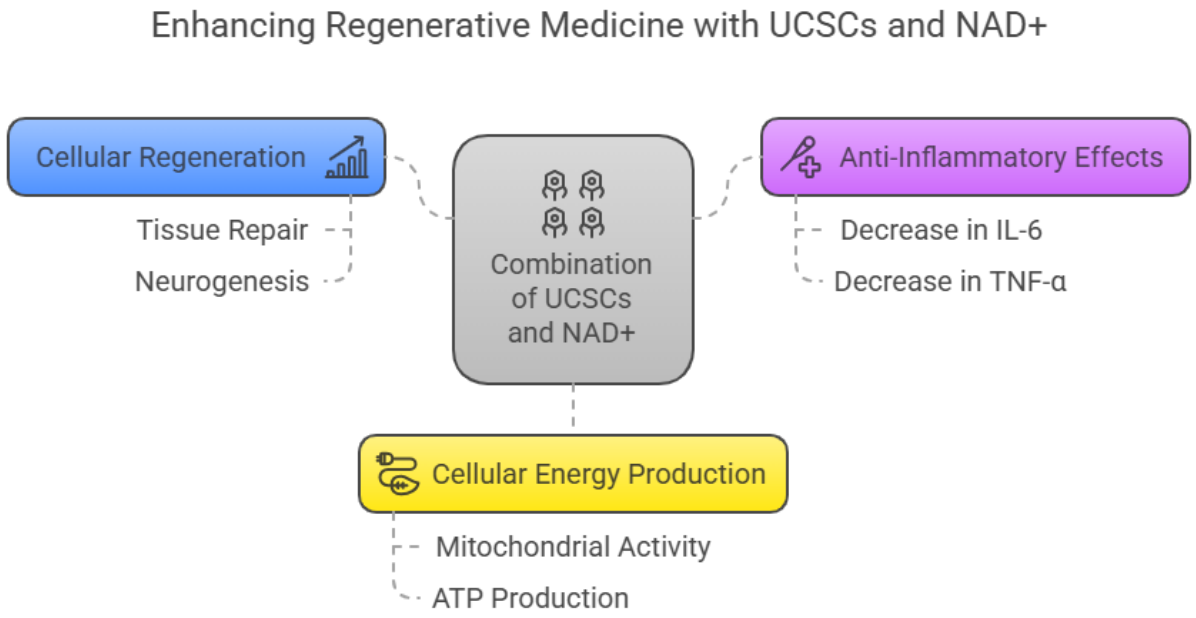
being (Verdin, 2015). The study identifies that NAD+ supplementation together with UCSCs helps restore cellular power generation by enhancing mitochondrial activity to produce ATP.



Cells produce most of their ATP inside mitochondria as these cellular structures maintain power over many age-related diseases that cause muscular dystrophy and neurodegenerative illness, and metabolic syndrome (Gomes et al., 2013). The capacity of UCSCs to create new mitochondria enhances their ability to enhance cell metabolic energy together with NAD+ supplementation. UCSC and NAD+ combination provides valuable therapeutic benefits for patients with chronic fatigue syndrome and fibromyalgia, given the widespread mitochondrial dysfunction observed in these conditions.

The elevated OCR paired with extra respiratory capacity measured in UCSC + NAD+ treated cells verifies the hypothesis about the boosted mitochondrial operation. The analysis demonstrates how UCSCs together with NAD+ could restore mitochondrial well-being, which enhances physical activities in senior adults while decreasing fatigue symptoms and improving metabolic efficiency. The long-term advantages from enhanced mitochondrial functioning following this discovery need additional research evaluation, particularly when applied to serious metabolic diseases.

4. Potential Clinical Applications and Future Directions

This study sets important foundations for healthcare applications that involve treating patients with NAD+ and UCSCs in clinical practice. Both compounds serve to tackle age-related degeneration simultaneously while protecting people susceptible to chronic diseases often seen in seniors. This treatment approach demonstrates potential for extensive medical applications because scientists can use it to develop treatments that benefit individuals who have arthritis in addition to people with cardiovascular disease and cognitive decline.

The research requires answers to fundamental unanswered questions. To establish safe and effective medical treatments, researchers need to determine the best doses of UCSCs combined with NAD+ in different health conditions. The short-term findings of this research study show promising results, yet we lack information about how UCSC and NAD+ therapy will affect aging and chronic diseases in the long run. The cost-benefit evaluation should be conducted regarding these treatments, especially when considering mass clinical applications.

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Future research should focus on developing combination treatment strategies as one of its major priorities. Future research needs to examine how UCSCs and NAD+ interact with other developing treatments from regenerative medicine, specifically including gene therapy and exosome-based therapies. Combined use of these therapies may lead to superior therapeutic effects, which will enhance the present treatment success for complex age-related conditions.
The experiments in this study present strong evidence that using UCSCs together with NAD+ might establish a promising therapeutic method that benefits cellular regeneration and minimizes systemic inflammation while strengthening cellular energy production in aging adults. Long-term safety assessment along with effectiveness testing of UCSCs and NAD+ treatment for age-related diseases requires extensive clinical trials to confirm current results and establish their medical benefits. The research provides a foundation for additional investigations about how regenerative medicine affects human aging, together with its capacity to enhance senior citizens' life quality.

V. CONCLUSION

This study reveals that umbilical cord-derived stem cells (UCSCs) provided by intravenous (IV) infusion together with Nicotinamide Adenine Dinucleotide (NAD+) show great potential to become a novel therapeutic approach for adults. The study results indicate that the combined use of UCSCs and NAD+ creates important advantages for cellular healing and anti-inflammatory actions, and cellular energy creation. The combined therapy between stem cells and NAD+ effectively differentiates cell populations while regenerating tissues and reduces inflammatory markers throughout the body, and changes mitochondrial function for treating age-related diseases.

Through their combined actions, UCSC and NAD+ treatment provide an innovative method to treat conditions affecting tissue health, such as neurodegenerative diseases and musculoskeletal disorders, and skin conditions related to aging. Through cell differentiation, UCSCs enable tissue repair, but NAD+ helps accelerate this repair by enabling better cellular energy production (Gomes et al., 2013; Li et al., 2017). As per Franceschi et al. (2018), chronic inflammation management through this therapy becomes possible because of its established anti-inflammatory properties. The combination of UCSCs and NAD+ fights both pro-inflammatory cytokines and promotes sirtuin function, thus providing an effective remedy against inflammaging, which characterizes aging (Rajman et al., 2018). The study results clearly show how healthy mitochondria enhance both cellular operation and overall body vitality. Research findings show that NAD+ treatment supported by UCSCs enhances mitochondrial function along with ATP synthesis, which demonstrates a promising therapeutic approach toward managing chronic fatigue and metabolic syndrome together with other energy disorders widespread among aging populations (Verdin, 2015). The therapeutic aspect shows great potential to advance physical as well as cognitive function in older adults.

Research studies need additional investigations to establish a complete understanding of sustained effects and safety aspects related to UCSCs and NAD+ therapy. All kinds of regenerative treatments require constant assessment of potential hazards like cancer development and the rejection of foreign material by the body, according to Liu et al. (2020). Developing optimal treatment parameters, especially dosage amounts and delivery approaches, will lead to addressing population-specific limitations in the effectiveness of this medical intervention. The clinical deployment of UCSCs and NAD+ therapy heavily depends on their cost-effective nature.

Results indicate that treatments involving UCSCs and NAD+ show potential to become effective medical solutions against age-related disorders and degenerative conditions. Scientific evidence from this study points toward future clinical trials and potential developments of patient-specific treatments that heal aging individuals. New research and additional refinement will allow UCSCs and NAD+ to become central elements in regenerative medicine development, which will lead to better life quality for older adults.

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