Research Article ISSN 2639-9512

Stem Cell & Regenerative Medicine

# Burned While Buzzed: The Impact of Alcohol Intoxication on Stem Cell Cytokines with Major Burns: Burned While Buzzed

**Dagmawi Demessie, MD, MS[1], Athena Hoppe, MD[1], Dhanushka Vitharana, MD[1], William M. Melito, MD[1], Jeffrey E. Carter, MD, FACS, FABA[1,2], Jonathan E. Schoen, MPH, MD, FACS, FABA[1,2], M. Victoria P. Miles EMT-P, MD[1,2] and Alison A Smith, MD, PhD, FACS[1,2*]**

[1]*Louisiana State University Health and Sciences Center, New Orleans, LA.*

[2]*University Medical Center New Orleans, LA.*

**[*]Correspondence:**

Alison A Smith, MD, PhD, FACS, Associate Professor of Clinical Surgery, Address: 2021 Perdido Street, New Orleans, Louisiana, Tel: 504568-4750.

**Received:** 06 Jul 2026; **Accepted:** 15 Aug 2026; **Published:** 24 Aug 2026

**Citation:** Dagmawi Demessie, Athena Hoppe, Dhanushka Vitharana, et al. Burned While Buzzed: The Impact of Alcohol Intoxication on Stem Cell Cytokines with Major Burns: Burned While Buzzed. Stem Cells Regen Med. 2026; 10(3): 1-4.

## ABSTRACT

***Background:*** *Adipose-derived stem cells (ADSCs) may be functionally altered by ethanol exposure at the time of burn injury. This study aimed to evaluate whether acute ethanol intoxication at the time of major burn injury alters the cytokine secretion profile of adipose-derived stem cells involved in wound healing.*

***Methods:*** *Adipose tissue was collected from adult patients with severe burn injuries at the index operation (n=26). ADSCs were extracted and cultured in vitro. Supernatants were harvested 30 hours after plating and used for cytokine determinations by multiplex cytokine assay. Fluorescence activated single cell sorting (FACS) confirmed their phenotype with markers CD 90, CD 166, and CD 73. Univariate analyses compared patients with ethanol intoxication (n=15) to those without (n=11) at time of injury.*

***Results:*** *Average blood ethanol concentrations on arrival were 121 +/- 41.7 mg/dL. predominant sample being male (23/26) and African American (15/26). The analyte assay demonstrated a significant decrease noted of fibroblast growth factor (FGF)-2 in patients with elevated blood ethanol content (p = 0.04). No significant differences in supernatant concentrations of IL-1 beta, IL-6, IL-8, TNF-alpha and IL-13 were observed (p>0.05).*

***Conclusion:*** *The results from this study suggest that ethanol intoxication at the time of major burn injury alters the profile of paracrine factors secreted from ADSCs. FGF-2 is integral to the wound healing process as it contributes to smooth muscle cell growth, wound healing, and cell migration. These results suggest further studies may be warranted to investigate FGF-2 as a target for future therapies or interventions.*

## Keywords

Burns, Ethanol, Wound Healing, Adipose-Derived Stem Cells, Cytokines.

## Abbreviations

EtOH: Ethanol, ICU: Intensive Care Unit, ADSCs: Adipose-Derived Stem Cells, FGF-2: Fibroblast Growth Factor 2, FACS: Fluorescence-Activated Cell Sorting, IL-1β: Interleukin-1 beta, IL-6: Interleukin-6, IL-8: Interleukin-8, TNF-α: Tumour Necrosis Factor-alpha, IL-13: Interleukin-13, CD: Cluster of Differentiation (used in CD90, CD166, CD73), TBSA: Total Body Surface Area.

## Significance Statement

Alcohol intoxication is common in people who sustain severe burn injuries and is known to worsen recovery. This study demonstrates that alcohol exposure alters the functional capacity

of adipose-derived stem cells by suppressing the secretion of a growth factor essential for angiogenesis and tissue regeneration. These findings suggest that alcohol not only affects the body as a whole but also disrupts the regenerative potential of stem cells themselves. Understanding this mechanism opens the door to new therapies that could restore healing in burn patients who are intoxicated at the time of injury.

## Introduction

Alcohol intoxication is frequently encountered in patients sustaining burn injuries, with studies reporting that nearly half of individuals admitted for burn trauma have detectable levels of ethanol upon hospital presentation [1]. A retrospective analysis utilizing the National Burn Repository data from 2002 to 2011 demonstrated that burn patients with blood alcohol concentrations exceeding the legal limit experienced significantly increased in-hospital mortality, prolonged ICU admissions, and extended durations of mechanical ventilation, highlighting the detrimental impact of alcohol intoxication on burn injury outcomes [2].

Experimental models have demonstrated that acute ethanol exposure exacerbates systemic inflammatory responses and impairs essential biological processes such as angiogenesis and immune regulation, thereby potentially compromising tissue repair and regeneration [3-5]. Clinical data further suggest that burn patients with elevated blood alcohol concentrations at the time of injury experience worse outcomes, including increased rates of infectious complications, and delayed wound healing [1,4,6].

Adipose-derived stem cells (ADSCs), a subset of mesenchymal stem cells, contribute to tissue regeneration and wound healing through paracrine signalling mechanisms, particularly via secretion of cytokines and growth factors that modulate inflammation, angiogenesis, and cellular proliferation [7-9]. In an exploratory study, ADSCs obtained from severely burned patients (total body surface area >20%) with acute ethanol intoxication (mean blood alcohol concentration ~121 mg/dL) exhibited significantly altered paracrine signalling, characterized by elevated secretion of cytokines such as IL-4, IL-10, IL-17, TNF-α, TGF-α, and IFN-γ, when compared to non-intoxicated controls indicating that ethanol may impair the regenerative and immunomodulatory functions of ADSCs in burn injury [10].

Given their prominent role in wound repair through paracrine signalling, alterations in the secretory profile of ADSCs in the context of ethanol intoxication may offer mechanistic insight into the delayed healing and increased complications observed in intoxicated burn patients. This study investigates whether acute ethanol intoxication at the time of burn injury alters the cytokine secretion profile of ADSCs derived from injured adipose tissue, with a specific focus on factors relevant to tissue healing and immune modulation.

## Methodology

The study was conducted at a Level 1 Trauma Center after obtaining approval from the local IRB. Adipose tissue samples were obtained from a total of 26 adult patients with severe burn injuries during the index surgical operation. Patients who are members of vulnerable populations, specifically pregnant women and prisoners as well as patients less than 18 years of age, were excluded.

ADSCs were isolated from the harvested tissue and cultured in vitro. Supernatants were collected 30 hours after plating for cytokine analysis. Phenotypic confirmation of ADSCs was performed using fluorescence-activated cell sorting (FACS), identifying the expression of CD90, CD166, and CD73 surface markers. A multiplex cytokine assay (Milliplex Human Cytokine/Chemokine/Growth Factor Panel A, Cat# HCYTA-60K, Millipore, USA) was employed to quantify the following cytokine concentrations in the collected supernatants according to the manufacturer's recommendations (pg/mL): IL-1β, IL-6, IL-8, IL-13, TNF-α, FGF-2. The samples were run in triplicate on a Bio-Rad Bio-Plex200 system, Luminex, Belgium)

For statistical analysis, cytokine levels were presented as the median, and univariate comparisons were made between two cohorts, patients who were ethanol-intoxicated at the time of burn injury (n=15) and those who were not (n=11), where statistical significance was defined as $p < 0.05$.

## Results

Average blood ethanol concentrations on arrival were 121 +/- 41.7 mg/dL with predominant sample being male (23/26) and African American (15/26). The mean age of the study population was 52 years. The overall mean TBSA was 37.6%, with a mean TBSA of 38.5% in the ethanol-intoxicated (EtOH+) group and 36.4% in the non-intoxicated (EtOH-) group. While most cytokine levels did not differ significantly between EtOH+ and non-intoxicated EtOH− groups, there was a trend toward higher IL-6 and IL-8 levels in the EtOH− group ($p = 0.12$ and $p = 0.07$, respectively). Notably, FGF-2 levels were significantly reduced in the EtOH+ group compared to the EtOH− group (0.00 vs. 23.46, $p = 0.04$), and the analyte assay demonstrated a significant suppression of FGF-2 in the supernatant of adipose-derived stem cells from ethanol-intoxicated burn patients (Figure 1). No significant differences were observed for IL-1β, IL-6, IL-8, TNF-α, or IL-13 (Table 1).

**Table 1:** Patient Characteristics and Cytokine Levels (pg/mL) Secreted by ADSCs Stratified by Ethanol Exposure Status.

| Characteristics | EtOH+ (15) | EtOH- (11) | P-value |
|---|---|---|---|
| IL-1β | 1.27 | 0.98 | 0.18 |
| IL-6 | 8.12 | 31.11 | 0.12 |
| IL-8 | 185.35 | 768.46 | 0.07 |
| IL-13 | 0.33 | 0.00 | 0.41 |
| TNF-α | 0.29 | 0.00 | 0.20 |
| FGF-2 | 0.00 | 23.46 | 0.04 |

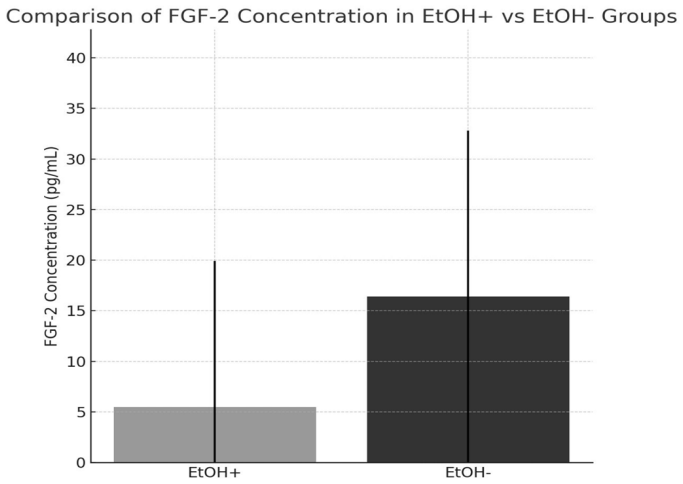


**Figure 1:** Comparison of FGF-2 concentration in EtOH+ Vs EtOH- groups.

## Discussion

In this study, ADSCs isolated from burn patients with acute ethanol intoxication exhibited a significant reduction in FGF-2 secretion compared to non-intoxicated controls, while levels of pro-inflammatory cytokines (IL-1β, IL-6, IL-8, TNF-α) remained unchanged. These findings shed light on the mechanistic role of ethanol intoxication in impairing wound-healing processes following burn injury.

FGF-2 is a critical mediator of angiogenesis and cellular proliferation, pivotal in early wound repair [11,12]. Previous research has shown that acute ethanol exposure disrupts angiogenic responses and delays wound healing [5]. Our finding of diminished FGF-2 release by ADSCs aligns with Radek et al.'s observations where ethanol suppressed proliferative and vascular responses essential for repair. Therefore, ADSCs may serve as a direct target through which ethanol attenuates tissue regeneration after burns.

The absence of alterations in key inflammatory cytokines secreted by ADSCs suggests that ethanol's primary derailment in this context is not via the amplification of inflammatory signals rather attenuation of reparative pathways. Previous clinical data have associated intoxicated burn patients with exaggerated systemic inflammation, increased sepsis risk, and impaired wound closure [6]. However, our results indicate that ADSC-mediated modulation of inflammation may be less affected than its role in facilitating regeneration.

Our results support and extend the findings from Smith, et al. [10], who reported altered paracrine signalling in ADSCs from intoxicated burn patients where elevated IL-4, IL-10, IL-17, TNF-α, TGF-α, and IFN-γ were associated with impaired healing phenotypes. While Smith et al. describe a broad shift in cytokine milieu, our work refines the understanding by identifying a selective suppression of FGF-2, which may represent a key mechanistic driver of ethanol-related impairments in wound healing.

Given the high prevalence of alcohol intoxication in burn patients on admission, our findings have important clinical relevance. The observed reduction in FGF-2 secretion by ADSCs highlights the need to consider ethanol intoxication as a modifier of stem cell function in burn care. Therapeutic strategies aimed at restoring FGF-2 activity, such as exogenous supplementation or ADSC preconditioning, may help mitigate these effects and improve healing outcomes in this high-risk population.

The limitations of this analysis were that it has a small number of patients captured at a single time point, which may not reflect the full temporal dynamics of ADSC paracrine signalling. Additionally, *in vitro* conditions may not fully replicate the complex wound environment *in vivo*. Future studies should incorporate longitudinal cytokine profiling, expand the range of analysed growth factors, and explore molecular mechanisms underlying ethanol-induced suppression of FGF-2. Correlating longitudinal cytokine profiles with clinical healing outcomes could further strengthen the translational relevance of this work.

## Conclusion

This study reveals a novel deficit in FGF-2 secretion from ADSCs of ethanol-intoxicated burn patients, reinforcing clinical observations of impaired healing in this population. By elucidating a specific mechanistic link, our results underscore the need to target angiogenic pathways in therapeutic interventions whereby potentially improving clinical outcomes.

### Conflict of Interest Statement

Dr. Miles serves as a consultant for Polynovo, Avita Medical, and Vericel, where in lieu of compensation all proceeds are donated to local burn charities to support outreach, education, and survivor burn programs.

Dr. Schoen serves as a consultant for Polynovo, where in lieu of compensation all proceeds are donated to local burn charities to support outreach, education, and survivor burn programs. Dr. Schoen also serves as a consultant for LivaNova.

Dr. Carter serves as a consultant for Avita Medical, PolyNovo, & Spectral MD where in lieu of compensation all proceeds are donated to local burn charities to support outreach, education, and survivor burn programs. Dr. Carter also holds stock options at Spectral MD.

Dr. Alison Smith is a paid speaker for Prytime Medical Advisory Board and Aroa Biosurgery.

## References

1. Silver GM, Albright JM, Schermer CR, et al. Adverse clinical outcomes associated with elevated blood alcohol levels at the time of burn injury. J Burn Care Res. 2008; 29: 784-789.
2. Pruitt BA, Wolf SE, Mason AD. Epidemiological, demographic, and outcome characteristics of burn injury. Total Burn Care. 2007; 14-32.

3. Bird MD, Kovacs EJ. Organ-specific inflammation following acute ethanol and burn injury. J Leukoc Biol. 2008; 84: 607-613.
4. Choudhry M A, Irshad H Chaudry. Alcohol Intoxication and post-burn Complications. Front Biosci. 2006; 11: 998-1005.
5. Radek KA, Matthies AM, Burns AL, et al. Acute ethanol exposure impairs angiogenesis and the proliferative phase of wound healing. Am J Physiol Heart Circ Physiol. 2005; 289: H1084-H1090.
6. Puyana S, Ruiz S, Amador F, et al. Effects of elevated blood alcohol levels on burn patient outcomes. Eplasty. 2021; 21: e8.
7. Balaji S, Keswani SG, Crombleholme TM. The Role of Mesenchymal Stem Cells in the Regenerative Wound Healing Phenotype. Adv Wound Care. 2012; 1: 159-165.
8. Zuk PA, Zhu M, Ashjian P, et al. Human Adipose Tissue Is a Source of Multipotent Stem Cells. Mol Biol Cell. 2002; 13: 4279-4295.
9. Rehman J, Traktuev D, Bovenkerk JE, et al. Secretion of Angiogenic and Antiapoptotic Factors by Human Adipose Stromal Cells. Circulation. 2004; 109: 1292-1298.
10. Smith A, Fontenot C, Carter J, et al. Impact of Ethanol Intoxication on Adipose-Derived Stem Cell Paracrine Factors in Burn Patients. Academic Surgical Congress. 2024.
11. Gragnani A, Tonarelli E, Chomiski V, et al. Fibroblast Growth Factor in the Treatment of burns: a Systematic Review. Burns. 2022; 48: 104-110.
12. Zhan DC, Shen YS, Zhao YR, et al. Efficacy and Safety of Basic Fibroblast Growth Factor in the Treatment of Burns. Medicine. 2019; 98: e15102.