Pressure Ulcer Mouse Model: What is it and how can I use it in my research?

Author: Andrea Alarcon Uquillas, BS.
Edited By: Xiying Wu, MD, Trivia Frazier, PhD MBA, Jeffrey M. Gimble, MD PhD

Pressure ulcers, most commonly known as pressure sores, bedsores, or decubitus ulcers, are localized injuries to the skin and its underlying tissues caused by prolonged pressure of the skin over bony surfaces[1]. Pressure ulcers are highly common in people of advanced age with limited mobility and in people who suffer from venous insufficiency, arterial occlusive disease, diabetes mellitus and para- or quadriplegia. In developed countries, pressure ulcers appear in 18% of nursing home residents and 7.9% in assisted living homes. Additionally, pressure ulcers account for 1-4% of the hospital budgets in industrialized nations. Currently, treatment options include surgical debridement, dressings and more experimental approaches such as, growth factors, hyperbaric oxygen, and negative pressure apparatus[2].

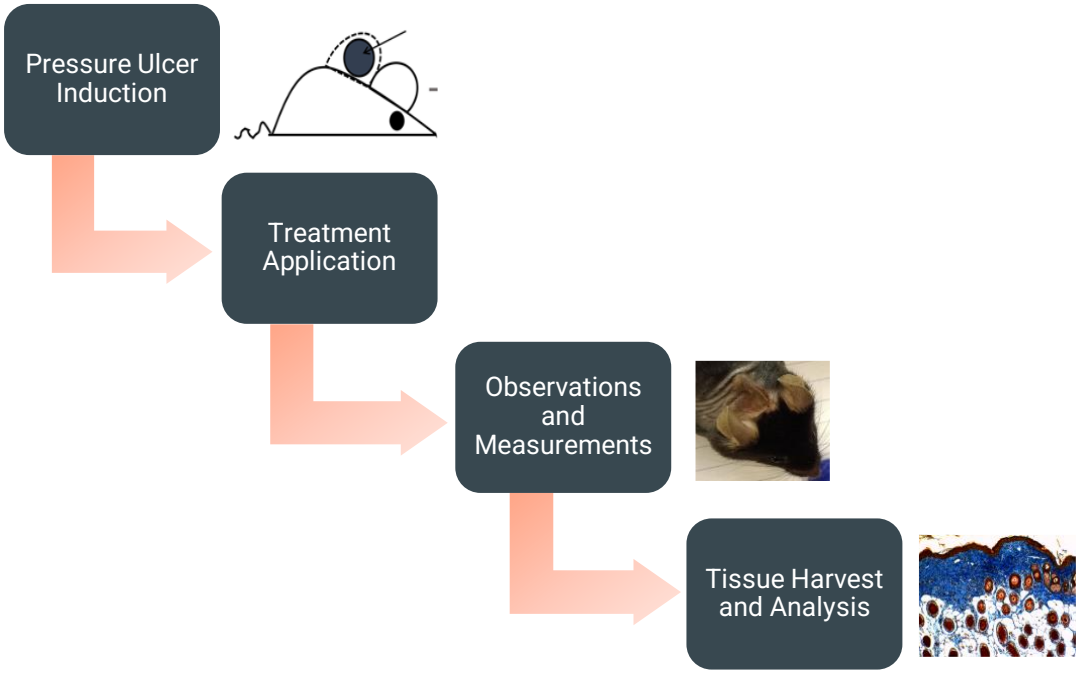
As the elderly population continues to grow, there will be a need to investigate improved treatments for pressure ulcers. To this purpose, Obatala Sciences™ has optimized a pressure ulcer mouse model that closely resembles to the pressure ulcer injury in humans. Our pressure ulcer model was optimized using mice from the strain C57BL/6. To create the pressure ulcer wound, the dorsal skin of anesthetized mice is shaved and positioned between 2 removable circular 12-mm diameter magnets. The magnets remain positioned in the dorsal skin of mice for 12-hours and then are removed for 12-hours, which corresponds to one ischemia reperfusion (IR) cycle. Previous studies demonstrate that two IR cycles are sufficient to create a reproducible induction of pressure ulcer injury; thus, our model follows this simplified injury induction[2]. After injury induction, the mice are treated with the selected interventions and observed for up to 14-20 days. Wounds are assessed daily for size, temperature, and skin architecture.

What types of treatments can be studied for this model?
Obatala's pressure ulcer mice model is suitable to study various types of therapies including cellular and exosome therapies. Additionally, our pressure ulcer mice model is suitable for therapies with biomaterials, such as extracellular matrix hydrogels. Historically, hydrogels have been used as sheets or patches in *in vivo* applications; however, hydrogels can also be modified further to be used as powder or an injectable solution[3]. These therapies can be applied as injections, topically, or other preferred method of application.

How are wounds evaluated after treatment?

Obatala Sciences, Inc.
2000 Lakeshore Dr. #4020
New Orleans, LA 70148
504-300-0266
www.obatalasciences.com

Wounds are evaluated daily for size using a digital carbon fiber caliper. Size is determined by the formula: radius of the length × radius of the width × π. Additionally, wounds are assessed daily for temperature using an infrared thermometer. Depending on the length of the study, skin wound samples are harvested from mice at different time points and analyzed for tissue architecture and re-epithelization based on histology.



Recent Publications:

a. **Safety and Efficacy of Human Adipose-Derived Stromal/Stem Cell Therapy in Immunocompetent Murice Pressure Ulcer Model**
Bukowska, J., Alarcon Uquillas, A., Wu, X., Frazier, T., Walendzik, K., Vanek, M., Gaupp, D., Bunnell, B. A., Kosnik, P., Mehrara, B., Katz, A. J., Gawronska-Kozak, B., & Gimble, J. M. (2020). Safety and Efficacy of Human Adipose-Derived Stromal/Stem Cell Therapy in an Immunocompetent Murine Pressure Ulcer Model. Stem cells and development, 29(7), 440–451. https://doi.org/10.1089/scd.2019.0244

b. **Safety of Human Adipose Stromal Vascular Fraction Cells Isolated with a Closed System Device in an Immunocompetent Murine Pressure Ulcer Model**
Bukowska, J., Alarcon Uquillas, A., Wu, X., Frazier, T., Walendzik, K., Vanek, M., Gaupp, D., Bunnell, B. A., Kosnik, P., Mehrara, B., Katz, A. J., Gawronska-Kozak, B., & Gimble, J. M. (2020). Safety of Human Adipose Stromal Vascular Fraction Cells Isolated with a Closed System Device in an Immunocompetent Murine Pressure Ulcer Model. Stem cells and development, 29(7), 452–461. https://doi.org/10.1089/scd.2019.0245

c. **A Novel, Sterilized Microvascular Tissue Product Improves Healing in a Murine Pressure Ulcer Model**
   Gimble, J. M., Frazier, T., Wu, X., Uquillas, A. A., Llamas, C., Brown, T., Nguyen, D., Tucker, H. A., Arm, D. M., Peterson, D. R., & Bunnell, B. A. (2018). A Novel, Sterilized Microvascular Tissue Product Improves Healing in a Murine Pressure Ulcer Model. Plastic and reconstructive surgery. Global open, 6(11), e2010. https://doi.org/10.1097/GOX.0000000000002010
d. **Adipose stromal cells repair pressure ulcers in both young and elderly mice: potential role of adipogenesis in skin repair**
   Strong, A. L., Bowles, A. C., MacCrimmon, C. P., Frazier, T. P., Lee, S. J., Wu, X., Katz, A. J., Gawronska-Kozak, B., Bunnell, B. A., & Gimble, J. M. (2015). Adipose stromal cells repair pressure ulcers in both young and elderly mice: potential role of adipogenesis in skin repair. Stem cells translational medicine, 4(6), 632–642. https://doi.org/10.5966/sctm.2014-0235

References:

[1]Salcido, R., Popescu, A., & Ahn, C. (2007). Animal models in pressure ulcer research. The journal of spinal cord medicine, 30(2), 107–116. https://doi.org/10.1080/10790268.2007.11753921

[2]Strong, A. L., Bowles, A. C., MacCrimmon, C. P., Lee, S. J., Frazier, T. P., Katz, A. J., Gawronska-Kozak, B., Bunnell, B. A., & Gimble, J. M. (2015). Characterization of a Murine Pressure Ulcer Model to Assess Efficacy of Adipose-derived Stromal Cells. Plastic and reconstructive surgery. Global open, 3(3), e334. https://doi.org/10.1097/GOX.0000000000000260

[3] Spang, M. T., & Christman, K. L. (2018). Extracellular matrix hydrogel therapies: In vivo applications and development. Acta biomaterialia, 68, 1–14. https://doi.org/10.1016/j.actbio.2017.12.019

Stadler I[1], Zhang RY, Oskoui P, Whittaker MS, Lanzafame RJ. Development of a simple, noninvasive, clinically relevant model of pressure ulcers in the mouse. J Invest Surg. 2004 Jul-Aug;17(4):221-7.