Challenge

Studying the effects of UV exposure on skin

Solution

UV irradiation of mice using the UVP Crosslinker

Studying the Effects of UV Radiation: From Tanning to Tumorigenesis

Abstract

The skin is an important physical barrier which is exposed to a variety of external insults, including ultraviolet (UV) radiation. UV exposure has numerous effects on the skin, ranging from a tanning response to development of skin cancers. As a result, it is critical to study how UV exposure of varying wavelengths and intensities impacts the skin. By incorporating the Analytik Jena UVP Crosslinker into experiments using mouse models, it is possible to study the effects of UV radiation on the skin.

Background

Given our regular exposure to UV radiation naturally from the sun or through artificial means such as tanning beds, it is important to study the complex effects of UV exposure on the skin.
In response to UV exposure, many cellular responses are triggered within the skin. UV exposure causes DNA damage in skin cells, resulting in the activation of various DNA repair mechanisms[1,2]. A tanning response is also common in response to UV radiation, which is important in blocking further damage to the skin[2,3]. These responses are critical in preventing excess UV exposure to the skin, which can cause painful and damaging sunburns, as well as increase the risk of skin cancers[1–4]. Given the spectrum of effects on the skin, there is a clear need to understand how UV radiation of different intensities affects the skin.

UV radiation can be subdivided into UVA, UVB, and UVC based on their wavelength[2,3]. These different wavelengths have different effects on the skin, due to their varying energies and ability to penetrate into layers of the skin[1,2]. In order to fully understand the skin's response to UV radiation, the effects of different subsets of UV radiation must be better studied.

The mouse model is often used in laboratory research, given their well characterized genetics and numerous strains to study different mutations and diseases[5]. To understand the associations between UV radiation and skin cancer, there are mouse models of melanoma[6–9] which are used to study the process of tumor initiation and melanoma progression. Additionally, there are models with fluorescently labeled cells which can be used to study processes such as the migration of melanocytes during the tanning response[10].

Analytik Jena's UVP Crosslinker can be used to expose mice to UV radiation of different wavelengths and intensities. The UVP Crosslinker can be equipped with UV tubes which emit UVA (34-0006-01), UVB (34-0042-01), and UVC (34-0007-01) and can be programmed to emit up to 10 J/cm^2 of energy. By using the UVP Crosslinker in conjunction with a variety of mouse models, it is possible to address a wide range of questions regarding the effects of UV exposure on skin.

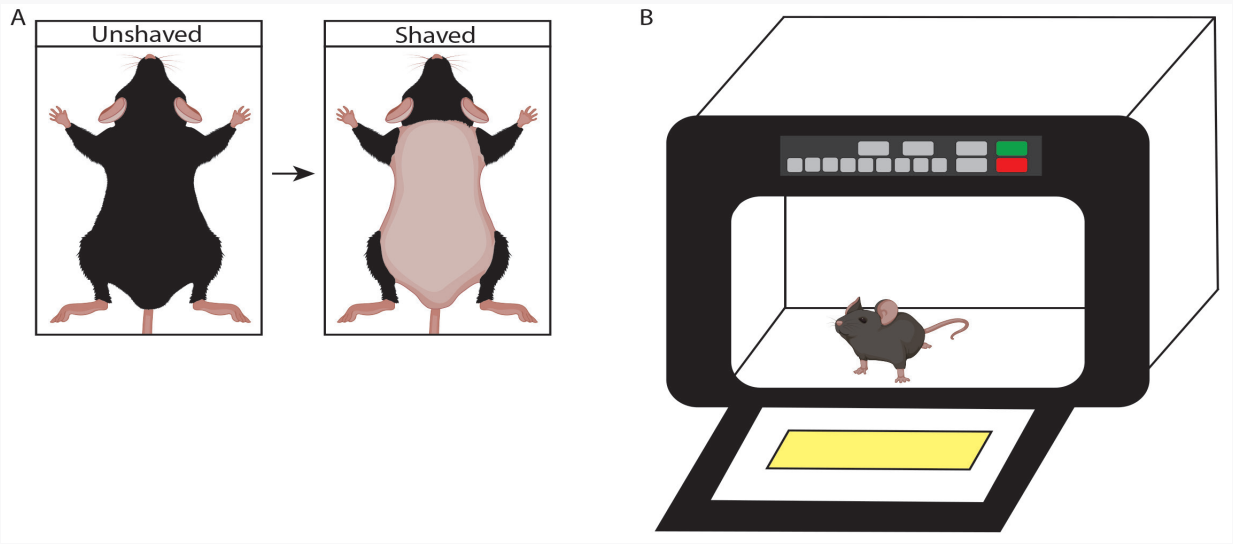


Figure 1. Workflow for UV irradiation of mice using UVP Crosslinker. A) Dorsal hairs of anesthetized mice are shaved to prepare for irradiation. B) Mouse placed inside UVP Crosslinker for UV exposure. Adapted from Biorender.com (2020). Retrieved from https://app.biorender.com/biorender-templates.

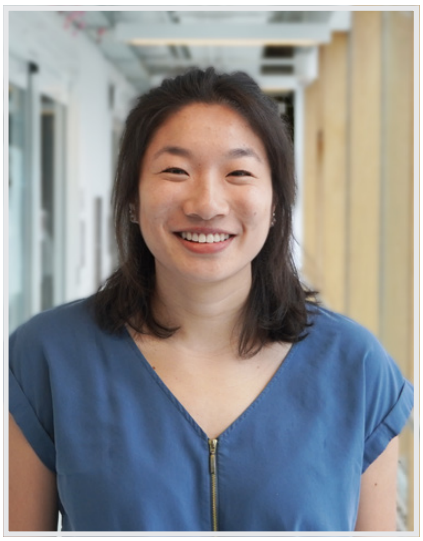
Operating the UVP Crosslinker for UV exposure of mice

To use the UVP Crosslinker in order to expose mice to UV irradiation, follow the directions below:

1. Prior to irradiation, clip the hairs on the dorsal skin of the mouse.
2. If desired, anesthetize the animals for UV exposure.
3. Place the animals into the UVP Crosslinker chamber and close the door.
4. Enter the desired UV energy output (mJ/ cm^2) using the keypad and press "Start".
5. Irradiate the animals. The built-in radiometer will stop UV exposure when the selected energy output has been reached.
6. Remove the animals and allow them to recover in a fresh, clean cage.

References

1. Jhappan, C., Noonan, F. P. & Merlino, G. Ultraviolet radiation and cutaneous malignant melanoma. Oncogene 22, 3099–3112 (2003).
2. D'Orazio, J., Jarrett, S., Amaro-Ortiz, A. & Scott, T. UV radiation and the skin. Int. J. Mol. Sci. 14, 12222–12248 (2013).
3. Nguyen, N. T. & Fisher, D. E. MITF and UV responses in skin: From pigmentation to addiction. Pigment Cell Melanoma Res. 32, 224–236 (2019).
4. Schadendorf, D. et al. Melanoma Primer. Nat. Rev. Dis. Prim. 1, 15003 (2015).
5. Jackson Laboratories. Why are mice considered excellent models for humans? Available at: https://www.jax.org/why-the-mouse/excellent-models.
6. Dankort, D. et al. BrafV 600E cooperates with Pten loss to induce metastatic melanoma. Nat. Genet. 41, 544–552 (2009).
7. Sun, Q. et al. A novel mouse model demonstrates that oncogenic melanocyte stem cells engender melanoma resembling human disease. Nat. Commun. 10, (2019).
8. Moon, H. et al. Melanocyte Stem Cell Activation and Translocation Initiate Cutaneous Melanoma in Response to UV Exposure. Cell Stem Cell 21, 665-678.e6 (2017).
9. Köhler, C. et al. Mouse Cutaneous Melanoma Induced by Mutant BRaf Arises from Expansion and Dedifferentiation of Mature Pigmented Melanocytes. Cell Stem Cell 21, 679-693.e6 (2017).
10. Chou, W. C. et al. Direct migration of follicular melanocyte stem cells to the epidermis after wounding or UVB irradiation is dependent on Mc1r signaling. Nat. Med. 19, 924–929 (2013).



"Using the skin as a model, it is possible to study the interactions between many different systems and cell types. I've always loved biology, but the more I studied, the more I realized how little we know. I feel lucky to spend every day working towards answering some of these questions."

Megan He

Analytik Jena US LLC
2066 W. 11th Street
Upland, CA 91786 · USA

Phone +1 909 946 3197
Fax +1 909 946 3597

info@us.analytik-jena.com
www.analytik-jena.com

en · 09/2020