



Evaluation of Post-Inflammatory Hyperpigmentation in a Porcine VCA Model

BACKGROUND

Post-inflammatory hyperpigmentation (PIH) arises following skin inflammation or injury. The severity and persistence of PIH often increase with darker skin tones, particularly in individuals with Fitzpatrick skin types III to VI. Swine skin is structurally, cellularly, and antigenically similar to humans, making them an appropriate animal for use in preclinical PIH studies.

Given these similarities, swine models provide a valuable opportunity to explore the pathophysiological changes involved in PIH development and persistence. Additionally, studying PIH in animal models may help identify early predictive markers that are challenging to observe in human clinical studies.

This study aimed to assess the utility of a porcine vascularized composite allotransplantation (VCA) model in examining histologically observed edema and initial skin pigmentation with the development of PIH as potential predictive markers. Findings from such research could enhance understanding of PIH mechanisms and inform targeted therapies for affected populations.

METHODS

Surgical Procedure

- Performed two autologous vertical rectus abdominus myocutaneous (VRAM) flap transplants on Yucatan pigs.
- Isolated VRAM flaps from the left lower abdominal quadrant and transplanted to the right anterolateral neck of the same pig, following established methods.

Edema Assessment

- Collected daily biopsies from graft sites to evaluate dermal and epidermal edema.
- Assessed dermal edema histologically, categorizing it as none, mild, moderate, or severe based on interstitial fluid accumulation.
- Quantified epidermal edema by measuring the distance from the deepest point of the stratum basale to the most superficial point of the stratum corneum.

Hyperpigmentation Evaluation

- Documented gross hyperpigmentation daily through photo documentation to monitor visible changes in pigmentation over time.

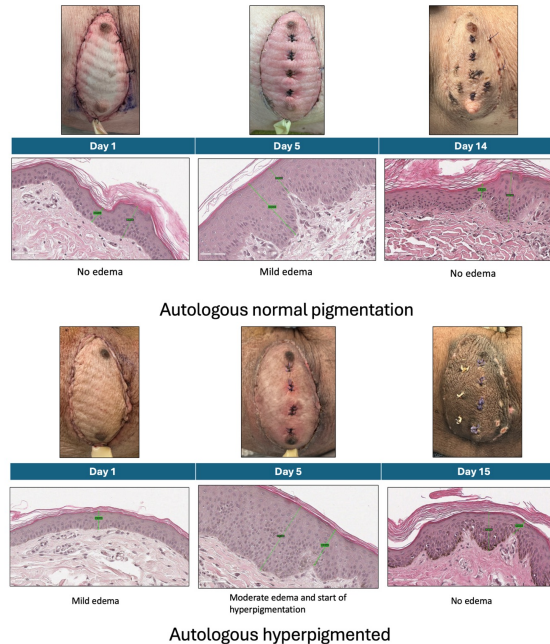


Figure 1: Gross images and histology of the autologous swine with normal pigmentation and post-inflammatory hyperpigmentation.

RESULTS

Correlation Between Edema Severity and PIH Development

- Observed a direct correlation between the severity of edema and darker baseline skin tone with PIH onset in autologous grafts.
- In one pig with moderate to severe edema, PIH was visible by postoperative day 5 (POD5).
- The other pig, with milder edema and a lighter baseline skin tone, showed no signs of PIH.

Histological Observations

- Hematoxylin and eosin staining revealed an increased prominence of melanocytes in the epidermis as edema severity increased.

Epidermal Thickness Changes

- The pig with PIH showed a 110.73 μm increase in epidermal thickness by POD5.
- The pig with normal pigmentation had a smaller increase in epidermal thickness, measuring only 71.37 μm by POD5.

CONCLUSIONS

Correlation Between Edema, Skin Tone, and PIH Development

- Findings indicate a clear correlation between post-surgical edema levels, baseline skin tone, and the development of PIH following autologous VRAM flap transplants.
- Moderate to severe edema consistently preceded the onset of hyperpigmentation, suggesting that increased edema in skin grafts may serve as a risk factor for PIH development.

Implications for Edema Management

- Although swine do not have a direct equivalent to the Fitzpatrick skin grading scale, these results highlight the importance of managing edema early after transplantation to potentially reduce the risk of PIH.
- Early intervention targeting edema control could be crucial for minimizing the incidence and severity of PIH.

Baseline Skin Tone and PIH Incidence

- Swine with darker baseline skin tones in this study developed hyperpigmentation, while those with lighter tones did not, mirroring the pattern of PIH commonly seen in humans.
- This supports the relevance of using porcine VCA models in future research to better understand PIH etiology, investigate risk factors, and explore potential therapeutic interventions.

Utility of Porcine VCA Models for PIH Research

- Results support the use of porcine VCA models as valuable tools for studying PIH mechanisms and developing targeted treatments.

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