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## Pigs as Dermatologic Models of Human Skin Disease

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### Introduction

In the past twenty years pigs have become increasingly important as models to study human disease and in the testing of new medical devices. Part of the popularity is based on better anatomic similarities to humans as compared to other large laboratory animals especially with regards to skin disease and cardiovascular disease. Also since pigs are recognized as food animals there is better acceptance by staff and public for their use as laboratory animals as compared to pet animals such as dogs. Finally, the purchase price of pigs is usually less than dogs but you can still purchase a particular breed so that there is less genetic variability. There are potentially four types of animal models. These include spontaneous models, experimentally induced, negative or non-models and orphan models. In this presentation the focus will be on primarily spontaneous models and experimentally induced. When picking any animal model the following criteria should be considered:

- A. Accurately mimic the desired function or disease
- B. Species availability
- C. Data extrapolatable to humans
- D. Be available to a large group of investigators
- E. Be able to be handled by the staff of most investigators
- F. Survive long enough to be functional
- G. Fit commonly used animal facility housing
- H. Be of sufficient size to provide multiple samples
- I. Should provide multiple offspring with each gestation

Pigs are well suited for skin studies. Although rat, mouse and rabbits have been used for skin studies, pig skin has been shown to be the most similar to human skin. Pig skin is structurally similar to human epidermal thickness and dermal-epidermal thickness ratios. Pigs and humans have similar hair follicle and blood vessel patterns in the skin. Biochemically pigs contain dermal collagen and elastic content that is more similar to humans than other laboratory animals. Finally pigs have similar physical and molecular responses to various growth factors. Though pigs are more expensive than laboratory rodents, pig skin wounds heal primarily by re-epithelialization rather than contraction so they are especially useful in studying wound healing and burn lesions. One primary disadvantage of pigs is that they can rapidly grow

to a large size and that they may become to large or difficult to handle in long term studies. This problem can usually be solved by using miniature pigs.

### Overview of Pigs Used in Skin or Dermatologic Studies

- A. Skin surgery
- B. Melanoma research
- C. Wound healing and therapies
- D. Burn studies and therapies
- E. Microbiology
- F. Laser therapy
- G. Aseptic necrosis
- H. Vitiligo and depigmentation
- I. Dry skin
- J. Managing and understanding hypertrophic scarring

The main focus of research use of this presentation will be wound healing, burn healing and therapies, use of laser therapy in treatment breast cancer, and the red Duroc pig as a model to study hypertrophic scarring. In 1979 Mertz and Eaglstein developed a novel porcine wound healing model that allowed multiple test sites on the dorsal skin. This model had multiple small wounded squares so that various treatment modalities and controls could be confined to a small area of the back of a single pig. This model has been refined and expanded to study various wound types such as partial thickness, full thickness, second degree burns, ischemic wounds, and infected wounds. Treatment modalities such as ointments, antibiotics, debridement, bandages and laser therapy can be evaluated. Wounds can be created by using specially designed dermatomes. Burns are created by heating brass rods in boiling water. Ischemic wounds are created creating a flap and separating from the underlying blood supply using a scalpel. Infected wounds can be created by inoculating wounds with known amounts of pathogenic bacteria. We will also review studies that use laser therapy rather than surgical excision for the minimally invasive therapy for cutaneous tumors such as breast tumor. We will show both gross and histopathologic images of a particular study. Finally we will review hypertrophic scarring using the female red Duroc pig. The red Duroc pig is a useful model to study this disfiguring disease of humans which is often both frustrating and difficult to treat. We will show both gross and histopathologic images of this disease in the pig.

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