Challenges in the Neonatal/Pediatric Wound Care Arena

Objectives

- Review the different categories of wounds seen in neonates and children.
- Understand the physiologic and structural differences between neonatal skin and adult skin.
- Review the different categories of pressure ulcers and how they present in neonates.
- Review the risk factors associated with pressure ulcers in neonates.
- Discuss wound care dressings that are safe and effective in neonates.
- Review the management of IV infiltrates in neonates.

Common Pediatric/Neonatal Wounds

- Contact Irritation
- Surgical Wounds
- Pressure Ulcers
- IV Infiltrates
- Trauma/Shear Injuries/Misc
- Infections
- Burns

Pediatric Wounds
Surgical Wounds

Infections

Trauma/Shear Injuries/Misc

Burn Injuries

Wound Healing Principles:

- Adequate Debridement
- Proper moisture balance
- Control of infection and inflammation
- Appropriate choice of dressing
- Recognizing differences in skin anatomy when approaching neonatal skin

All Skin Is Not Alike
Unique features of Neonatal Skin

- Skin does not mature until 34 weeks gestation.
- Skin integrity of premature infants is weak and far from complete.
- Stratum corneum is the outermost section of the epidermis. Composed of nonviable skin cells packed on top of each other to create a protective barrier.
- Key function of Stratum corneum is to control transepidermal water loss (TEWL) and to prevent absorption of toxic substances.

Stratum Corneum

- In full term infants and adults, the stratum corneum is 10-20 layers thick.
- Premature neonates <30 weeks have less than 2-3 layers.
- 23-24 week preemies have virtually no corneum.

Basement Membrane

- In premature infants, the connection at the dermal-epidermal junction is weak due to fewer hemidesmosomes and anchoring fibrils. They are also spaced further apart.
- Trauma to the epidermis can therefore arise when removing adhesive dressing in which the bond between adhesive dressing is stronger than bond between dermis and epidermis.
- This factor therefore places the premature infant at greater risk for blistering or thermal insults.

Dermis

- The dermis of premature infants has less collagen and fewer elastin fibers.
- This increases the risk for edema.
- Edema can in turn raise the risk for pressure ulcers and other ischemic injury due to reduced blood flow.

Neonatal Pressure Ulcers

A pressure ulcer in a baby?
I thought these only arose in the elderly?

Definition

A pressure ulcer is localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear.

A number of contributing or confounding factors are also associated with pressure ulcers—moisture, nutrition, tissue perfusion, mobility and activity.
Incidence and Prevalence

- The literature on the incidence and prevalence of neonatal pressure ulcers remains limited.
- From pediatric data that does exist, most of the studies have focused on populations considered high risk for pressure ulcers: NICU, PICU and Pediatric Cardiac.
- Most available studies cite an incidence rate ranging from 5% to 23% in neonatal patients.
- As in adults, multiple factors (some preventable) can result in a pressure ulcer.

Staging of Pressure Ulcers

- Stage I
- Stage II
- Stage III
- Stage IV
- Suspected Deep Tissue Injury
- Unstageable

Stage I: Non-blanchable erythema

- Intact skin with non-blanchable redness of a localized area usually over a bony prominence.
- Darkly pigmented skin may not have visible blanching. Its color may differ from the surrounding area.
- The area may be painful, firm, soft, warmer or cooler as compared to adjacent tissue.
- May indicate “at risk” patients.

Stage II: Partial thickness

- Partial thickness loss of dermis, presenting as a shallow, open ulcer with a red/pink wound bed, without slough.
- May also present as an intact or open insulated serum-filled or sero-sanguinous filled blister.
- Presents as a subtle or dry shallow ulcer without slough or bruising. *Bruising indicates deep tissue injury.
- This category should not be used to describe skin tears, tape burns, incontinence-associated dermatitis, maceration or excoriation.
Stage III: Full thickness skin loss

- Full thickness tissue loss.
- Subcutaneous fat may be visible but bone, tendon or muscle are not exposed.
- Slough may be present but does not obscure the depth of tissue loss.
- May include undermining and tunneling.
- Bone/tendon is not visible or directly palpable.

Stage IV: Full thickness tissue loss

- Full thickness tissue loss with exposed bone, tendon or muscle.
- Slough or eschar may be present.
- Often includes undermining and tunneling.
- Category/Stage IV ulcers can extend into muscle and/or supporting structures (e.g., fascia, tendon or joint capsule) making osteomyelitis likely to occur.

Unstageable: Full thickness skin or tissue loss – depth unknown

- Full thickness tissue loss in which actual depth of the ulcer is completely obscured by slough (yellow, tan, gray, green, or brown) and/or eschar (tan, brown or black) in the wound bed.
- Until enough slough and/or eschar are removed to expose the base of the wound, the true depth cannot be determined. Both will be either Stage III or IV.
Suspected Deep Tissue Injury – depth unknown

- Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear.
- The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to the surrounding tissues.
- Deep tissue injury may be difficult to detect in individuals with dark skin tones.
- Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar.
- Evolution may be rapid exposing additional layers of tissue even with optimal treatment.

Risk factors for Neonatal Pressure Ulcers

- Identifying babies at risk for pressure ulcers is the key to their prevention.
- Among neonates and children, 50% of pressure ulcers are equipment and device related (nasal prongs, CPAP masks, tubing, lines, tracheostomy devices, O2 monitors and bedding).
- Acutely ill and immobilized neonates are at high risk for pressure injuries. Such patients are often nutritionally challenged, which directly affects skin integrity.
- Extremely premature infants less than 32 weeks are at greatest risk for pressure ulcer.
Effective Dressings in Neonatal Wounds

Collagen Dressings

- Dressing which contain collagen derived from human or animal sources to facilitate granulation.
- Stimulate macrophages, angioblasts, keratinocytes and other growth factors.
- Provide a scaffolding for host cell proliferation and migration.
- Promote healthier balance between inflammatory mediators in the wound.
- Can be changed anywhere from daily to weekly.
Collagen Dressings
- Per manufacturer – "Limited data on the prolonged use in children and neonates.
- No side effects or complications have ever been encountered with the application of collagen based dressing to facilitate granulation and closure of open wounds.
- Overall safe and effective means of closing a wound following effective debridement in neonates and children.

Silicone Bordered Foam
- Excellent choice for secondary dressing to cover wounds in neonates.
- Soft and highly conformable foam dressing that absorbs exudate and maintains a moist wound environment.
- Atraumatic to the wound and surrounding skin upon removal
- May be lifted and adjusted without losing its adherent properties
- Minimizes the risk of maceration
- May remain in place for several days depending on the condition of the wound.

Cyanoacrylate Skin Protectant
- Non-cytotoxic liquid barrier that quickly dries and forms a bond with skin surface when applied.
- Single application typically lasts 2-3 days.
- Protects skin from prolonged exposure to urine, stool and other body fluids.
- Protects from friction and maceration
- Remains in place until the epidermal cells naturally slough away.
- Nonirritating and safe in preemies and infants.

Cyanoacrylate Skin Protectant Indications:
- Skin protection under medical devices:
  - G tubes, tracheostomy tubes, ostomy sites, oxygen tubing, negative pressure devices
- Skin protection for fragile or compromised skin:
  - Perianal area
  - Periwound
  - Skin tears
  - Surgical sites

Honey based Dressings
- Derived from the pollen and nectar of a specific Leptospermum species of plant in New Zealand.
- Unique among all types of honey – maintains its effectiveness even in the presence of wound fluid.
- Aids in the removal of necrotic tissue and helps advance the wound toward healing through two key mechanisms of action – high osmolality and low pH
- Numerous reports have shown antimicrobial effects of honey.
Safety and efficacy of active Leptospermum honey in neonatal and pediatric wound debridement.

*J Wound Care.* 2015 Mar;24(3):95-103

- Data were collected on 115 neonatal and pediatric patients, with 121 wounds requiring debridement, treated with ALH.
- Patients treated with ALH in the United States between October 2011 and March 2014 at eight different inpatient facilities and one outpatient clinic.

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**Management of IV Extravasation Injuries**

**Dr. Amaya’s Protocol**

**Management of infiltration and extravasation**

The recommended immediate management is:
- Immediately stop the infusion/injection.
- Leave the cannula/port needle in place temporarily.
- Aspirate as much of the residual drug as possible.

**Under no circumstances should the device be flushed.**
- Disconnect IV tubing or syringe containing drug but retain it to determine amount of drug infused.

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**Management of infiltration and extravasation**

- Early intervention and identification of the first signs and symptoms of infiltration and extravasation is crucial. In order to prevent serious adverse outcomes.
- This is time dependent and should be considered an urgent situation any time of the day or night.
- Goal is to reduce additional trauma and injury from occurring.
- Documentation will be an important aspect for legal purposes.
- Contact attending physician and consider wound care consultation.

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**Management of infiltration and extravasation**

- The affected limb should be elevated.
- Application of a cool or warm compresses to the site has previously been recommended but is dependent upon the type of infusion/vesicant and amount extravasated within the wound.
- Therefore no temperature related compresses are recommended.
- Gently clean the IV site once the needle is removed of all fluids and debris.
- I do not recommend administration of hyaluronidase. In my experience it does not improve outcome and may add additional injury to the site.
Management of infiltration and extravasation

- Application of Active Leptospermum Honey (ALH) dressing in my personal experience has multiple benefits and excellent outcomes. This should be performed as soon as the injury is identified.
- Apply silicone bordered foam dressing over the honey
- Gently wrap the extremity in Coban from fingertips/soles proximally to wrist/ankle. This will support absorption of the fluid into the lymphatics.

Debridement

- After eschar has sufficiently softened crosshatching of the tissue is important to allow the ALH to penetrate the wound
- Thereafter, the eschar easily peels away after an additional 48-72 hours of ALH

Case Discussion

26 week premature infant female with severe IV infiltrate secondary to Vancomycin

Eschar crosshatched using scalpel at bedside to facilitate penetration of Leptospermum honey into wound bed

Active Leptospermum honey applied regularly to facilitate debridement. Typical firm eschar develops within wound bed.

3 days later eschar is sharply debrided
Soft tissue defect requires treatment to "fill in" wound bed. Wound vac applied at bedside using "Amaya" technique.

Wound Vac "Amaya Technique" To Reduce Excess Contact Between Skin and Vac

Ultimately epithelialization and closure of the wound is obtained using placental graft. Alternative would be standard collagen dressing.

Success! = Happy Mom & Dad (and Hospital Attorney)
Summary

Neonatal skin has multiple unique anatomical factors which increase the risk for additional injury or absorption of toxins. Choosing an appropriate dressing should focus not only on recognized wound healing principles but also to avoid additional harm and reduce pain. Pressure ulcers do arise in neonates and careful attention is required to avoid their development. Many advanced wound care products have shown to be both safe and effective in the infant and children. The management of IV extravasations requires careful debridement and application of dermal templates to facilitate closures. Advanced products shown to be safe. ALH and collagen products have been shown to be excellent tools for this condition. Don’t be afraid to ask for help!