Mending Tender Skin: 
Care for Skin Breakdown including 
Diaper Dermatitis, IV Infiltrates and Wound Care

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Skin Assessment: Which Scale?

- Braden Q, Starkid Skin Scale
  - Assess risk for pressure sores, skin breakdown in pediatric patients
  - Number of neonates in each study not indicated, no premature infants included
- Neonatal Skin Condition Score (NSCS)
  - Used in original Neonatal Skin Project
    - Sample 2,820 neonates
    - Validity, reliability demonstrated using data set from project (Lund & Osborne 2004)

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Braden Q

Starkid Skin Scale

Pressure Sores in Neonates

Neonatal Skin Condition Scale

- Dryness:
  - 1 = Normal, no signs dryness
  - 2 = Dry skin, visible scaling
  - 3 = Very dry skin, cracking/fissures
- Erythema:
  - 1 = No evidence erythema
  - 2 = Visible erythema, <50% body surface
  - 3 = Visible erythema, >50% body surface
- Breakdown:
  - 1 = None evident
  - 2 = Small, localized areas
  - 3 = Extensive
    - Perfect score = 3
    - Worst score = 9

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Skin Assessment

- Neonatal Skin Condition Score (NSCS) recommended in 2007 guideline:
  - Objective scale quantifies overall skin condition
  - Does not replace head-to-toe assessment
  - May be linked to actions: consult with skin team/CNS, emollient use, skin culture, etc
  - Need to identify infants at high risk for pressure sores: HFV, hypotension/hypoperfusion, ECMO, NCPAP

Diaper Dermatitis

- Irritant contact diaper dermatitis (IDD)
- Candida (fungal) diaper dermatitis
- Combination

Pathogenesis IDD

- Wetness
  - Maceration of stratum corneum, impaired skin barrier function
- Friction
  - Mechanical trauma from skin-to-diaper contact
- Urine and feces
  - Ureases in stool release ammonia
  - Increase in skin pH
  - pH activates proteases and lipases, disrupts epidermal barrier

Risk Factors for IDD

- Malabsorption
  - Short bowel syndrome
  - Infectious diarrhea
  - Opiate withdrawal
- Fecal incontinence
  - Hirschsprung’s disease
  - Ano-genital malformations
- Atopic dermatitis (altered barrier function)
- Wearing diapers!

Diapers

- Frequent changes
  - Every 3-4 hours, more frequently in neonates
- Super-absorbent diapers bind fluid with a gel matrix
- Breathable covering
  - Permeable to air and vapor, impenetrable to leaks
- Petrolatum liners
- Diaper wipes: +/-
  - Wide range of brands, chemicals in formulations
  - Fragrance, preservative free are best
  - Some reported to cause allergic contact hand dermatitis in mothers

Biomedical Assessment and Instrumental Evaluation of Healthy Infant Skin

- 52 healthy infants 3-6 months of age
- TEWL, SCH, friction measured after night diaper removed before bathing, at 2 and 17-18 minutes after bath with liquid cleanser
- Compared diapered to non-diapered skin
- pH higher in diapered skin
- TEWL, SCH, erythema higher in diapered skin and in freshly bathed non-diapered skin
- Skin measurements improved at 17-18 minutes after bathing

Skin Care in the NICU Patient:
Effect of wipes vs. Cloth and Water on Stratum Corneum Integrity

- 130 NICU infants, 23-41 weeks, 30-51 weeks when studied
- RCT: wipe A, wipe B or cloth/water
- Measured TEWL, erythema, pH, SCH, skin condition every day
- TEWL, erythema ↓ with wipes
- pH lower with wipe B (acidity as preservative)

Premie Diapers?

Contact Irritant Diaper Dermatitis:
Create a Barrier
“frosting-on-a-cake”

Ingredients in Diaper Dermatitis
Treatments

- Zinc oxide
- Petrolatum
- Pectin
- Dimethicone (silicone)
- Plastic polymers
- Lanolin
- Glycerin
- Cholestyramine

Barrier Films

- Plastic polymers sprayed or wiped on skin to protect from trauma
- Alcohol-free products less irritating to skin
- Cavilon is FDA approved in infants >30 days as diaper dermatitis treatment, peri-ostomy skin protection
- Other manufacturers haven’t approached FDA

Candida Diaper Rash

- Fiery red, satellite lesions
- Distributed on thigh, perineum
- Treat with antifungal ointment (not powder)
Fungal Diaper Dermatitis Products

Combination Diaper Rash
- Dust with antifungal powder
- Seal powder on with skin protectant
- Apply thick layer of barrier

Treat the Underlying Cause!
- Diarrhea from malabsorption, opiate withdrawal, infection
- May need change in formula to reduce frequency of stooling

Diaper Dermatitis
- Contact irritant or candida?
- Primary irritant is fecal enzymes
- Use protective coating: zinc oxide, pectin paste, plastic polymer to protect skin from re-injury
- Candida diaper dermatitis: antifungal ointment
- Avoid products with multiple chemicals
- Bathing may help
- Consider a “diaper holiday” as long as no fecal contact

Potential Causes of Neonatal Skin Breakdown
- Top Down Injuries
  - Adhesive removal
  - Epidermal stripping
  - Burn/thermal injury
    - Dehydration
    - Dissease
  - Diaper/ostomy dermatitis
  - Infection
- Bottom Up Injuries
  - Pressure Ulcers
  - Infection
  - Surgical
  - Dehiscence

Keratinocytes and Fibroblasts and Wound Healing
- “Fibroblasts are principal cells involved in tissue repair and remodeling: To close the wound, fibroblasts migrate into the wound bed, populate fibrin-based matrix, synthesize collagen... initiate tissue contraction process.”
- “Keratinocytes proliferate and differentiate to reestablish the epidermal barrier.”
Toxicity from Skin and Wound Cleansers

- Most toxic to fibroblasts, which help to repair deep tissue, wounds:
  - Dove moisturizing body wash, Hibiclens, Dial Antibacterial soap, Ivory Liqui-gel
- Most toxic to keratinocytes, which repair epidermal barrier:
  - Hydrogen peroxide, povidone iodine
- These agents can delay healing in wound care

Skin Breakdown

- “Never put anything on a wound that you wouldn’t put in your eye”
- Protect breakdown from irritants, such as disinfectants, cleansers
- Ointments promote healing

Effects of Petrolatum on Stratum Corneum Structure and Function

- Adult skin injured with acetone
- Applied petrolatum BID
- Used TEWL to measure changes in barrier function
- Improved barrier function (TEWL) with petrolatum
- May organize intracellular bilayers, improve initial healing process
- Grease is good!

Silicone Dressings

- Protect skin from irritation

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Temperature Probe in the Armpit? Why Not???

- Skin in the axillary has decreased barrier function, more fragile
- “Intertriginous” areas include neck, groin, antecubital
- Also, if probe in axilla, temperatures change when baby lifts arm; more temp fluctuations
- Not really a “skin” temperature

Avoid triple antibiotic ointment; Muciprocin for staphylococcus infections

Ostomy Care in Neonates

- Gastrostomy
- Tracheostomy
- Jejunostomy
- Ileostomy
- Colostomy

Gastrostomy with Breakdown

- Antimicrobial ointment
- Silicone dressing

Ileostomy with Breakdown
Products: Skin Protectant, Paste, Powder, Barrier and Pouch

Finished!

Protecting Central Line

Ileostomy with Prolapse, Hernia

One Piece Pouch
Preventing IV Infiltrates

• Insertion site clearly visible
• Check every hour
• Keep IV site out of swaddling blankets
• Tape at joint: knee for foot, elbow for hand
• OR no arm- or foot-board at all!
• Avoid tape or wraps that constrict venous return

Preventing IV Infiltrates: Other Issues

• Avoid calcium-containing infusions whenever possible
• If calcium in IV fluids, consider placing two IVs and “rotating” sites for infusion
• Are intermittent boluses of calcium less irritating to veins compared to continuous infusion?
• Consider PICC line if: vasopressors, calcium infusions, irritating meds (Vancomycin, Amphotericin, NaCl/Methicillin/Penicillin, Acyclovir)

Characteristics of Infiltrates Requiring Intervention

• Swelling
• Pain at site
• Blanching or coolness of skin
• Leakage at site
• Erythema
• Severe cases: blisters, ischemia

Hyaluronidase and Phentolamine

• Vitrase: www.istavision.com
• Amphadase: www.amphastar.com
• Doses 15-20 units, 1 cc volume injected at 5 sites around periphery
• Do not use for vasopressors; phentolamine (Regitine) is antidote

IV Infiltrates: Multiple Puncture Technique

• Disinfect skin
• Analgesia
• Puncture at 5-10 sites with 22-24 gauge needle
• Apply saline soaked gauze
• Compress to release more fluid
Multiple puncture technique

Hyaluronidase + Puncture + Gel/Bag
- Vitrase (hyaluronidase) 20 units
- Deliver 0.2 ml in 5 sites around periphery of infiltrate
- No need to change needles

Hyaluronidase + Punctures + Gel/Bag
- Puncture to release extravasated fluid
- Use 23 gauge or greater
- Don’t be timid
- May repeat hyaluronidase, punctures
- Apply hydrogel, bag

Approach to IV Infiltrates (CHO)
- Use combination of hyaluronidase and multiple puncture technique
- No time frame, although earlier is best
- Be aggressive to allow extravasated fluids to leak out; several “rounds” may be needed
- Use bag/boot method with hydrogel immediately after punctures, hyaluronidase

Antimicrobial Ointment with Silicone Dressing
Some Wound Healing Principles

- Avoid use of disinfectants, cleansers in wound
- Irrigation provides gentle debridement
- Culture and treat infection

Wound Care Dressing Categories

- Absorption dressings
- Alginates
- Debriding agents
- Foams/composites
- Gauze

Excellent article: Fox MA (2011) Wound Care in the Neonatal Intensive Care Unit; Neonatal Network, 30:291-303

Beware: the Use of Silvadene Cream in Neonates

- Toxicity reported due to topical absorption
- Kernicterus
- Neutropenia
- Leukopenia
- Agyria

What????????
Initial Nonoperative Management and Delayed Closure for Treatment of Giant Omphaloceles
Lee et al., J Pediatr Surg (2006), 41:1846-9

- 22 giant omphaloceles treated over 21 years (19 containing liver)
- Silver sulfadiazine dressings, loose elastic bandage
- No complications associated with use of silver sulfadiazine
- Mortality rate 9.1%
Hydrogel Dressing

Healing after 40 Days

Wound Dehiscence

Irrigate Wound

Protect Surrounding Skin

Apply Skin Barrier

Absorbent Polyurethane Dressing
Dressing Before and After

Old School: Wet-to-Dry

New Age: Wound Vac

How Does the Wound Vac Work?

• Negative pressure produces macrostrain and microstrain
  – Macrostrain: visible stretch, occurs when negative pressure contracts the foam
  – Microstrain: microdeformation at cellular level, leads to cell stretch
    • Decreased edema, better perfusion, promotes granulation by facilitating cell migration and proliferation
  • www.kci1.com/KCI1/sciencebehindthetherapy#howitworks

Conclusions

• Prevent skin breakdown if possible
• Avoid irritants to healing skin
• Moist wounds heal faster with less scar tissue