Neonatal Skin Injuries

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Disclosure

• I have no financial relationships with the manufacturers of any commercial products – although I wish I had the perfect tape!
Objectives

• Recognize differences in premature, infant, adult skin
• Identify MARSI prevention
• Identify optimum skin care products for the NICU patient
Skin Injuries

- Understand skin
- Evaluate products
- Prevention essential – not focus on treatment
Adaptation to Extrauterine Environment

• Warm, hydrated, friction-less sterile environment

• Sudden exposure to oxygenated harsh extrauterine environment – fraught with micro-organisms, wide temperature & humidity changes

• Skin has to evolve for present and future survival
Neonatal Skin: Anatomic and Functional Differences

- Neonatal stratum corneum 30% thinner than adult, epidermis 20-30% smaller
- Keratinocyte cells smaller, higher cell turnover rate wounds heal faster!
- Dermis has shorter collagen fibers, absent reticular layer skin feels softer!
Stratum Corneum: Comparison of Adult, Term and Premature Infant

- Fetal skin development starts 4-5 wk
- By 4th month epidermis & dermis show clear architectural arrangement – but minimally functional
- Minimal SQ fat
- 10x TEWL
- Rapid maturation over first 2 weeks – but can take 4 weeks

(Neonatal Skin: Structure and Function, 1982)
Premature Infants and TEWL

- 23 weeks
  - 75 gmH\textsuperscript{2}O/m\textsuperscript{2}/hr
- 26 weeks
  - 45 gmH\textsuperscript{2}O/m\textsuperscript{2}/hr
- 29 weeks
  - 17 gmH\textsuperscript{2}O/m\textsuperscript{2}/hr
- 32-40 weeks:
  - 5-10 gmH\textsuperscript{2}O/m\textsuperscript{2}/hr
Cohesion Between Epidermis and Dermis

- Top 2 layers of skin connected by fibrils
- Fewer and further apart in premature infants
- Implications for adhesive removal

(Neonatal Skin: Structure and Function, 1982)
Medical Adhesives

• Different grades of medical adhesives
• Critical devices……..
• Challenging environments
• Not all acrylate adhesives are the same
Medical Adhesives

- Tape
- Dressings
- Electrodes
- Ostomy supplies
- Patches
- Securement devices
- IV securements
- Temp and O₂ sensor probes
- Tegaderm
- DuoDerm
- Derma Gel
- Mepilex dressings
- Many others…
Medical Adhesives in the NICU

- Acrylates (Transpore, paper, cloth)
- Zinc oxide (pink tape)
- Hydrocolloids (Duoderm, Brava)
- Hydrogel (electrodes)
- Polyurethane + acrylate (transparent dressings)
- Silicone
Silicone Adhesives

- Adhere well to skin, hair
- Gentle when removed, can be replaced
- Won’t stick to plastic
MARSI
Medical Adhesive Removal Skin Injury

Adhesive removal is the primary cause of neonatal skin injury
Epidermal Stripping
What causes epidermal stripping?

A. Aggressive tape adhesive
B. Tackifiers such as mastisol/benzoin
C. Incorrect tape removal
D. Frequent re-taping of the same area
E. All of the above
MARSI Skin Injuries

Skin tears

Tension Blisters

Children's Mercy
Kansas City
Irritant Contact Dermatitis

Transparent dressing  Hydrogel EKG electrodes
How can Contact Dermatitis from medical adhesives be prevented?

A. Assure skin is clean & dry before applying tape
B. Avoid using tackifiers such as Mastisol/Benzoin
C. Protect skin with alcohol-free skin prep, allowing to dry completely before applying tape
D. All of the above
What can we do?

• Skin preparation
• Adhesive product selection
• Adhesive product application
• Adhesive product removal
Skin Prep

- Body part: contoured or flat? Potential to stretch? Edema, distention or movement?
- Skin condition: dry or moist? Oily? Intact or damaged?
- Length of wear: short time or longer wear time?
- Allow any skin prep to dry completely
- Remove excessive hair?
- Make sure skin is clean and dry
- AVOID tackifiers like Mastisol/Benzoin – Routine use not recommended in newborns – can increase epidermal stripping
Silicone Barrier Films

- Plastic polymers sprayed or wiped on skin to protect from trauma
- Alcohol-free products less irritating
Adhesive Product Selection

• What level of securement is needed?
  • Critical securement or heavy tubing such as ET or NGT.
  • Low to medium adhesion for anchoring dressings or securing lightweight tubes/devices such as IV tubing.
• Choose gentlest tape for the job
• Minimize touching the adhesive—reduces ability to secure
Application techniques

- Choose gentlest tape for the job
- Minimize touching the adhesive—reduces ability to secure
- Apply with sufficient pressure to activate pressure-sensitive adhesives – but not stretched
- Spiraling down/up tubing adds securement with more surface area covered
- Secure the TUBE (omega technique/chevron) $\Omega$
- Tape parallel to an incision: consider where tape needs to stretch
- Pressure needed at site? Place tape on one side of dressing, stretch over dressing and place on next side
- Tape parallel to an incision
Adhesive Product Removal

• **DO NOT grip and rip!!**
  – Causes tenting of skin and separation of layers!
• **L-O-W and S-L-O-W**
  – Fold back adhesive onto itself and peel back slowly
• Transparent dressing – stretch to release adherence
• Adhesive removers
Adhesive Removal Products

- Alcohol/organic based solvents
  - Contain hydrocarbon derivatives or petroleum distillates
  - Toxicity
  - Case report of skin injury & hemorrhage after exposure to Detachol
- Oil based solvent
  - Paraffin based, mineral oil, citrus based
  - Oily residue.....can’t replace adhesive
- Silicone-based remover

Black, 2007
Transparent Dressing

**Application**
- Don’t stretch as put down
- Press down for activation “walking” the border off

**Removal**
- Use “tape tabbing”—place tape over one edge of film and pull back until the dressing begins to lift
- Stretch to break the adhesion
- Support skin under film where stretch is occurring
Pressure Injury

- Device related
- Immobility
- Procedures
Pressure Injury
What are strategies to prevent pressure injuries?

A. Pad devices
B. Rotate devices such as NIV CPAP interfaces
C. Reposition baby
D. Remove linen wrinkles, caps/items/stuff in the bed
E. Assess the skin under medical devices frequently
F. Pressure redistribution surfaces
G. All of the above
Disinfectants

• Necessary

• Evaluate risk/benefit
  – efficacy
  – systemic toxicity potential…..preservatives
  – skin irritation, chemical burns
  – contact dermatitis
Disinfectants

- Increased risk of toxicity
- Stratum corneum less developed
  - 2-3 layers in premature < 28 weeks
  - Term newborn more layers but 30% thinner c/w adults
- Ratio surface area/body weight increased ..... Increased absorptive surface
- Immature detoxification mechanisms in newborns – kidney/liver
- Skin more permeable & fragile in some areas
  - Antecubital, groin, axilla, groin (intertriginous areas)
• There is evidence available to recommend a single skin disinfectant product for all neonates.

A. True
B. False
Disinfectants

- Chlorhexidine gluconate (CHG)
  - 2% CHG Aqueous
  - 0.5%, 2%, 3.15% in 70% alcohol
- Providone Iodine
- Isopropyl alcohol
Disinfectants - Efficacy

- **Adults**: CHG reduces CLABSI risk; CDC strongly recommends for insertion & dressing changes
- **Neonates**: CHG reduces skin colonization, reduces blood culture contamination but no evidence for reducing CLABSI
  - Longer dwell times
  - Skin only 20% source of infection
  - 70% due to intraluminal (tubing source)
  - Care of IV tubing, line access most important

Mermel, L. *Clin Infect Dis*, 2011
Disinfectants – Thyroid Dysfunction

• 12-33% of exposed premature infants had thyroid dysfunction; 0 if not exposed

• Exposure of very premature infants to topical iodine disinfectants causes thyroid dysfunction – the extent and long term effects unknown

Aitken J. & Williams F., Arch Dis Child Fetal Neonatal Ed., 2014
Disinfectant – CHG & Toxicity

- Chemical burns
- Irritant contact dermatitis
  - Clings to the stratum corneum cells even after rinsing
- Anaphylaxis
  - Mucous membranes, repeated exposure surgical prep,
- Neurotoxicity
  - CHG inhibits neurite growth, ?? if CHG crosses the blood-brain barrier
  - 70% had measurable CHG levels – increased 2 days after exposure

Lund, Advances in Neonatal Care, 2018
Disinfectants - Alcohol

• Chemical burns
  – reported in babies 24-36 wk
Skin Antisepsis in Neonate
What Should We Use?

- No robust evidence to recommend any topical antiseptic over another
- Large trials with clinically relevant endpoints are now underway
  - CHG/70% IA vs PI prior to PICC or umbilical catheter insertion in preterm infants; n=304 (European Medicines Agency)
  - Efficacy study comparing 2%CHG/IA vs. 2% aqueous CHG for PIV insertion; 462 infants <1500 g; primary outcome bacterial colony count (NLM, Clinical Trials #NCT01270776)
- Survey indicates that 61% of NICUs use CHG
  - some restrict by weight, GA

Ponnuamy, et al., Curr Opin Infect Dis, 2014
FDA labeling for CHG/alcohol products

• “Use with care in premature infants less than 2 months of age. These products may cause irritation or chemical burns.”
What should be done to minimize the risk of skin irritation and chemical burns when disinfecting skin before invasive procedures?

A. Avoid pooling of solutions under the baby
B. Remove all disinfectants as completely as possible with sterile water or saline after the procedure is complete
C. Use sterile water only for skin antisepsis before an invasive procedure
D. A & B
Diaper Dermatitis

- Prevention is key
- Standardized approach
References

References

• McManus Juller, J. (2018). Infant skin care products – what are the issues?. Advances in Neonatal Care. 16(5S) S3-S12.
• Mermel, LA. (2011). What is the predominant source of intravascular catheter infections? Clinical Infectious Diseases, 52, 211-212.