Course Objectives

At the end of this lecture, the participant will be able to:

- Compare characteristics of preterm versus full term skin
- Identify preventative measures to avoid skin breakdown
- Review mechanisms of skin injury
- Facilitate care to heal injured skin
The Skin as a Neurodevelopmental Interface

Skin, meet Brain. I understand the two of you have a lot in common.
Functions of the Skin
Largest organ of the body...

- Protective barrier
- Temperature regulation
- Active role in immune system
- Sensory

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The Epidermis

- Outermost layer
- Main function is a barrier
  - Prevents absorption of fluid in utero
  - Prevents dessication
  - Prevents absorption of toxins and microorganisms
- Retains water and heat

The Stratum Corneum

- The outermost layer of epidermis
- The stratum corneum is constructed like a brick wall-the keratinocytes are the tightly packed bricks and the lipid layer is the mortar
- This layer varies in thickness from 0.05mm to 0.1mm
The Dermis

- Lies directly under the epidermis
- Anchored to the dermis by the basal layer
- It is a closely woven layer of fibrous protein imbedded with collagen and elastin fibers. This gives the dermis its elasticity and tensile strength
- Also contains mast cells, inflammatory cells, blood and lymph vessels and cutaneous nerves
- Development of this layer begins at about 11 weeks gestation

Fetal Skin Development

- 21-24 weeks:
  - Skin is wrinkled, translucent, and pink to red in color because blood in the capillaries have become visible and there is thin epidermis
Fetal Skin Development

• 26-29 weeks:
  – Subcutaneous fat and collagen begins to be deposited and starts to smooth out the many wrinkles
  – Sweat glands form

• 30-34 weeks:
  – Skin is pink and smooth
  – Fingernails reach fingertips
  – Lanugo begins to shed

• 35 to 38 weeks:
  – Fetus begins to plump up
  – Skin is white or bluish pink in caucasian infants
Variations in Neonatal Skin

- **Underdevelopment of Stratum Corneum, thinner skin.**
  - *Infants born at 22-25 weeks may require 5-7 weeks to develop functional layer*

- **Decreased cohesion between epidermis and dermis**

- **Increased susceptibility to infection, toxicity from topically applied substances**
  - *Topical administration can equal IV administration*

- **Excessive evaporative heat and fluid losses**

Risk Factors for Skin Breakdown in Infants Include:

- Gestational age <32 weeks
- Poor nutrition
- Edema
- Immobility
- Need for IV therapies
- Hypotension, and need for vasopressors
- Presence of medical devices: tubes, drains and monitoring equipment
- Surgical wounds
- Ostomies
Unique Properties of Preterm Skin:

- Skin accounts for 3% of adult body weight
- In preterm infants it accounts for 13% of total body weight
- The skin of a premature neonate is 40-60% thinner than adult skin

• Increased skin permeability in the preemie therefore:
  – Increased risk of infection from pathogens
  – Increased risk of toxicity from topically applied products
  – Increased TEWL (trans-epidermal water loss) through skin due to insufficient layers of Stratum Corneum to keep water in
  – Increased risk of irritation/epidermal stripping
Unique Properties of Preterm Skin:

- **Heat loss:**
  - Thin skin, decreased subcutaneous fat stores and immature thermoregulatory system = cold baby
- **Skin pH:**
  - Initial skin pH in newborns is about 6.34 which gradually decreases to about 4.95 within 4 days
  - Skin pH less than 5 provides bacteriocidal protection against pathogens
  - For this reason, only pH neutral products should be used for the initial bath or water only

Skin Care Goals

- Maintain skin integrity & promote normal skin development
- Prevent injury
  - Mechanical
    - Pressure, Shear, Skin stripping, Trauma
  - Thermal
    - From monitoring devices (SpO2, Tcom)
  - Chemical
    - Irritants, Incontinence, Extravasation injury
- Other injury:
  - Infection, Vascular Compromise, Congenital Skin Conditions
Bathing

- Immediate bathing not necessary unless for infectious reasons
- Only bathe when maintaining stable temperature for several hours
- Use warm sterile water on babies with breakdown or pH balanced soap and water
  - Premature infants <32 weeks, only water for first 2 weeks
- Use soft cloth or cotton balls
- Following baths should be no more than q 48hrs
The Acid Mantle

- At birth the skin pH is more alkaline at about 6.34
- The skin pH eventually drops of the first days to 4.95
- The skin’s acid mantle provides a state of equilibrium for the skin’s normal bacterial flora which provides protection against invading pathogenic organisms including fungus
- Frequent bathing disrupts the acid mantle and increases risk of infection

Bathing: What the Evidence Shows


Every 4th day bathing of premature infants appears to be safe
Vernix—Don’t Rub it Off, Rub in IN!

Vernix: The Literature

- Protection against infection
- Decreased skin permeability and transepidermal water loss (TEWL)
- Skin cleansing
- Moisturization of the skin surface
- pH development
- Wound healing
- Temperature regulation
Skin Care Goals

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WARNING: Graphic Pictures
Pressure Injury:

- A localized damage to the skin and/or underlying soft tissue
  - usually over a bony prominence
  - or related to a medical or other device.
  - The injury can present as intact skin or an open ulcer and may be painful.
- Occurs as a result of intense and/or prolonged pressure or pressure in combination with shear.
- The tolerance of soft tissue for pressure and shear may also be affected by microclimate, nutrition, perfusion, comorbidities and condition of the soft tissue.

– 4/2016 Revised definitions by NPUAP

How do pressure injuries occur?

- Pressure slows the blood flow to an area which leads to tissue death
- “Friction” and “shear” can add to the problem
Why does it matter?

- Pressure injuries are painful
- Pressure injury incidence is a nursing quality indicator
- Medicare and Medicaid have designated pressure injuries as "Never Events"
- No reimbursement for treatment of some pressure injuries
- Cost to heal a single full thickness pressure injury can be as high as $150,000
- Skin injury may contribute to complications
  - Increased risk of infection
  - Functional abnormalities
  - Permanent scarring
  - Often patient’s report pressure injury to be the most painful
  - Longer hospital stay

Who is at risk?

All NICU patient’s less than 37 weeks are at risk!
**Skin Assessment:**
- On admission, transfer, and after any procedure lasting >3 hours, then every shift
- Inspect the skin Q shift for signs of pressure injury, especially non-blanchable erythema
- Assess skin near and under medical devices at least every shift (splint, catheter, tube, brace)
- If order written to not reposition or remove a device, discuss concern with ordering provider. If order remains report to unit CNS immediately.
- When inspecting darkly pigmented skin, look for changes in skin tone, temperature, and tissue consistency compared to adjacent skin

**Skin Inspection**
- Spread buttocks/cheeks, assess occiput
Where do you suspect pressure injuries to occur?

Pulse Oximetry Application Tips:

- Select correct sensor
- Correctly apply sensor:
  - Star (emitter) to the sky
  - Black square (detector) directly opposite star
  - Apply gently, assure adherence, avoid tourniquet type fit
  - Sensor cord direction can be either toward or away from the patient
- Choose best application site based on clinical assessment of your patient
  - Apply sensor to patient first then attach to cable—“Sensor detects light, not life”
- Meticulous Assessment
NIPPV: Incidence of skin breakdown

- Skin breakdown “... even after only a few hours of ventilation, is a frequent complication, ranging from 2-23%”.
- “In one study, where patients were continuously ventilated with a face mask for more than 48 hours, this percentage reached 70%”.

Nasal CPAP

A
B
C

Full Thickness Tissue Loss
Stage III nasal trauma.

Why We Shouldn’t Cover Pressure Points if There is No Breakdown…
Blanching with Excessive Pressure

“Snubbing”
NG tubes

- Frequent assessment
- Minimize pressure from medical devices
- Specialty mattresses for infants at risk

Pressure Ulcer Prevention
Optimal Use of Specialty Mattresses:
▪ More than one layer between baby and mattress decrease effectiveness

▪ One layer can be:
  • Mattress Cover
  • A Pillowcase
  • One thin blanket

Skin Care Goals
▪ Maintain skin integrity & promote normal skin development
▪ Prevent injury
  • Mechanical
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  • Thermal
    – From monitoring devices (SpO2, Tcom)
  • Chemical
    – Irritants, Incontinence, Extravasation injury
▪ Other injury:
  – Infection, Vascular Compromise, Congenital Skin Conditions
Mechanical Injury: Skin Stripping and Trauma

Fragility of Epidermal/Dermal Connection

- Diminished cohesion between dermis and epidermis places premature infant at higher risk for injury
Medical Adhesive-related Skin Injury: Skin Stripping Treatment

- Cleanse
- Hydrate
- Reduce shear
- Insulate

Adhesives

- Use only when necessary
- Always use an alcohol-free skin protectant when possible under any tape or dressing applied to a neonate’s skin
- Minimize use of medical tape directly on skin
- Utilize silicone or hydrocolloid adhesives when possible
- Avoid adhesive bandages (Band-aids) on heel sticks, puncture sites if possible especially with VLBW babies
- Use adhesive removal aids when possible
Lasting Effects: Tape

▪ Subtle linear scars on leg of a former 27-week GA baby at site of IV

Photo courtesy of Erin Mathes MD

Skin Care Goals

▪ Maintain skin integrity & promote normal skin development
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▪ Other injury:
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Mechanical Injury: Thermal

Skin Care Goals

- Maintain skin integrity & promote normal skin development
- Prevent injury
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Mechanical Injury: Chemical

- Irritants & Toxins
- Incontinence, Diaper Dermatitis
- Extravasation injury

Lessons Learned: Permeability

- “CYANOSIS IN NEWBORN BABIES CAUSED BY ANILINE-DYE POISONING”
- Routine Hexachlorophene Bathing
- Povidone Iodine
Bacitracin: Things to Consider

- Bacitracin has been noted as one of the 12 most frequent allergens causing a positive patch test reaction in patients ages 8–92 years

Disinfectants

- Disinfecting skin surfaces before invasive procedures reduces the risk of infection and contamination
- Disinfectant solution should be chosen based on careful evaluation of safety for preterm and term infants
- Any disinfectant applied to the skin should be cleansed off after the procedure
Chlorhexidine Gluconate (CHG)

- At UCSF use of 2% CHG in 70% Isopropyl Alcohol may be used when infant meets all 3 of the following criteria:
  - >27 weeks
  - >1000
  - >7 days

- Based on:

Skin Disinfectants: The Evidence

- Why do we have criteria for CHG?

- Four of 36 (11%) infants < 1000 grams exposed to 2% aqueous chlorhexidine developed severe skin irritation (all had erythema and one progressed to breakdown with exudates). The study used 2% chlorhexidine for all central & arterial catheters and PIVs for infants <1000 grams and<14 days and 1% chlorhexidine in ethanol for all other IVs. (Anderson 2005)
CHG Considerations

- It is critical that CHG be allowed to air dry for 30 seconds so that isopropyl alcohol can evaporate
- Failure to allow drying has been associated with chemical burns

Povidone Iodine

- Povidone Iodine should be used to disinfect skin for preterm infants who do not meet criteria for CHG
- Apply Povidone Iodine in an outward circular motion and allowed to dry per manufacturer recommendation
- Clean off completely with Saline Wipe or sterile water after use to prevent chemical irritation and absorption
Povidone Iodine Considerations

Incontinence, Diaper Dermatitis & Moisture Management
Moisture Management…

- Urine is composed of 95% H2O, 5% organic solutes, primary urea
- Normal skin has a pH of 5.4-5.0 (acid environment) this has an antibacterial effect limiting pathogenic organisms.
- Urinary urea decomposes on the skin to form ammonium hydroxide which is an alkaline substance and raises the skin pH, which favors bacterial proliferation.
- Feces degrade the skin barrier function

General Diaper Care

- Avoid friction or rubbing when cleaning
  - to Desitin or not to Desitin…?
- Use superabsorbent diapers and change frequently
- Avoid scented wipes
- Identify infants at risk for diaper dermatitis
  - Hyperbili babies, infants with neurogenic bowel/bladder, “short gut” syndrome, antibiotic therapy
  - For infants at risk, apply Petrolatum/Aquaphor or Zinc ointment with every soiled diaper cleaning and changing to provide a protective barrier
DD Topical Applications:
Positive recommendations

▪ **Zinc oxide** AWHONN, 2007; Baldwin, et al., 2001; Hoggarth et al., 2005; Lund et al., 1999; Nield & Kamat, 2007; Wananukul et al., 2006

▪ **Petrolatum** AWHONN, 2007; Atherton, 2001; Hoggarth et al., 2005; Lund et al., 1999; Odio et al., 2000

▪ **Frequent Diaper Changes**: AWHONN, 2007; Atherton, 2004; Borkowski, 2004; Kazaks & Lane, 2000; Nield & Kamat, 2007

DD - Negative Recommendations

▪ **Open to Air** Lund et al., 1999

▪ **Antibacterial Products** AWHONN, 2007; Lund et al., 1999

▪ **Powder** Darmstadt & Dinulos, 2000; Farrington, 1992
Diaper Care

<table>
<thead>
<tr>
<th>Dressing change frequency</th>
<th>Indications for use</th>
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<tbody>
<tr>
<td>PRN or Q diaper change</td>
<td>• Diaper dermatitis prevention</td>
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<tr>
<td></td>
<td>• Mild redness without breakdown</td>
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<tr>
<td></td>
<td>• “frosting” a cupcake</td>
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Irritant Contact Diaper Dermatitis

- Present on convex surfaces
- Creases may be spared
- This could be a combination rash
- Protect injured skin
Candida Rash (Yeast)

- Assess for Candida and treat if needed
- Notice creases are involved
- Satellite pustules are present
- May occur simultaneously with oral thrush
- Frequent diaper changes needed
- “Open to air” may be required
**DD with Ulcerations**

- Although “open to air” approach may help temporarily, contact with urine or stool will reinjure skin
- This baby would benefit from barrier paste
Diaper Dermatitis Algorithm

**Prevention**
- Risk Factors: For patient’s with these risk factors, implement prevention:
  - Neonates receiving antibiotics
  - History of diaper dermatitis
  - Parent/caregiver expresses need for preventative intervention
  - Frequent loose stools
  - Myelomeningocele patients

**Intervention**
- Risk Factors: For patient’s with these risk factors, implement intervention:
  - Skin erythematous (red) or breakdown present
  - Steroid therapy (>5 days)
  - Immunosuppression
  - Post-operative patient with Hirschsprung’s Disease or anorectal malformation
  - IBD: Crohn’s Disease or Ulcerative Colitis
  - Post-operative stoma closure
  - Post-operative colectomy without stoma

**Apply Aquaphor or Critic-Aid Clear Q diaper change**

**General Tips for Prevention or Intervention:**
- Change diaper frequently
- Use disposable dry wipes or water wipes (ICN)
- With each diaper change, gently remove soiled layer of ointment, avoid revealing skin
- Avoid excessive rubbing/wiping/cleansing of diaper area
- Goal is to always have a layer of barrier product on skin, reapply as necessary
- Bathe daily or per unit standard
- Use Baza Cleanse to remove barrier (typically in conjunction with bath)

**Intervention**
- Erythema/Excoriation
  - Apply thin layer of Critic-Aid Clear
- Fungal Infection Treatment
  - Apply Antifungal first, followed by Critic-Aid Clear

Skin Healed?

**General Tips for Prevention or Intervention:**
- Change diaper frequently
- Use disposable dry wipes or water wipes (ICN)
- With each diaper change, gently remove soiled layer of ointment, avoid revealing skin
- Avoid excessive rubbing/wiping/cleansing of diaper area
- Goal is to always have a layer of barrier product on skin, reapply as necessary
- Bathe daily or per unit standard
- Use Baza Cleanse to remove barrier (typically in conjunction with bath)
- Refer to Incontinence/Diaper Dermatitis Treatment Guidelines for further instruction

**Crusting Technique: Applied daily or Q48 hours**
1. Cleanse skin and pat dry.
2. SPRINCLE Stomahesive Powder directly on the skin to include the open or irritated areas. Dust off excess powder.
3. USE Cavilon to “blot” or “dab” gently on top of stoma powder. THIS WILL SEAL THE POWDER INTO THE SKIN. After 10-15 seconds, a “crust” will form on the skin providing protection.
4. May repeat for extra layer of protection if necessary

**Apply Antifungal first, followed by Critic-Aid Clear**

Skin Healed?

May stop intervention or continue use of Critic-Aid Clear

No

If there is no change after 3 days contact unit CNS

Options in collaboration with CNS
- Consider Irrigation Consult or Wound Care Team
- Apply Stomahesive Powder, Cavilon (pruning technique), thick layer of Critic-Aid Clear, Stomahesive Powder
- Apply Stomahesive Powder, Cavilon (pruning technique), thick layer of Destro, Stomahesive Powder 6e

*Material services product PMM #: 44378 Dry disposable wipe
42553 Critic-Aid Clear
17518 Derma
17518 Aquaphor
14328 Cavilon Wound Stoma barrier film
43587 Stomahesive powder
43587 Stomahesive powder
MD Rx:
- Topical Antifungal: Fluconazole, Clotrimazole, or other
DD: Things to Consider

▪ Prevention is key
▪ Follow diaper dermatitis care plan
▪ Try plan for 24-48 hours to see if it is working
▪ For problem cases consult expert

Take home points…

▪ The skin of a premature infant, is essentially, wounded
▪ Prevention of further injury for all infants is essential
▪ Bathe minimally, using pH-neutral cleanser when appropriate
▪ Assess for pressure injury and utilize pressure reducing devices
▪ Utilize diaper dermatitis protocol, assessing 24-48 hours and involving CNS if needed
▪ Minimize adhesives
▪ Selective use of topical antiseptics, with removal after application
References


Questions?

Tanya.hatfield@ucsf.edu

Thank you!!