Objectives of Presentation

- Define suspected deep tissue injury according to the NPUAP staging guidelines.
- List accepted pathological mechanisms causing a pressure ulcer.
- Describe intrinsic and extrinsic risk factors in developing pressure ulcers.
- Contrast the differences in the pathology of pressure ulcers related to deformation versus ischemia.

Scope of the Problem in US

- Pressure injuries affect 3 million adults a year
- 60,000 people per year die from pressure ulcers
  - Nearly twice as many as caused by MVA
- Patients 65 years and older accounted for 72.3 percent of all acute hospitalizations where PU were noted
  
  Russo, April 2006
Scope of the Problem in US

- 60% of those with SCI develop pressure injuries during lifetime
- More than 1 in 10 nursing home residents have a pressure ulcer
- Varying conditions across all age groups
- $15\text{ BILLION}$ the government spent on PU treatment in 2003
  
  Russo, April 2006

2016 NPUAP Update: www.npuap.org

“Pressure Injury:
A pressure injury is 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. The injury 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, co-morbidities and condition of the soft tissue.”

The Reality of Pressure Injuries

- A global health care concern
- Extends to the entire health care team
- Responsible for prevention and treatment of pressure ulcers
- Cost of readmission (HAC)

Historical Knowledge

Healthy Skin – Lightly Pigmented

Blanchable vs Non-Blanchable

Blanchable

Non-Blanchable

Stage 1 Pressure Injury - Lightly Pigmented
But What About …

Deep Tissue Pressure Injury

- 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 adjacent tissue.

NPUAP/EPUAP, 2014
Deep Tissue Pressure Injury

- 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.

PI: Contributing Factors – SCI

Intrinsic Factors

- Age
- Level and Completeness of Injury
- Duration of Injury
- History of prior pressure injuries
- Incontinence and microclimate control
- Medical co-morbidities
- Cognitive impairment

Extrinsic Risk Factors

- Pressure
  - Not changing positions often enough, surface/contact area/immersion, tight or wrinkled clothing, etc.
- Shear
  - Less pressure needed to cause skin breakdown when shearing forces are occurring
  - May not be visible on the skin’s surface (deep)
- Friction
  - Not a primary cause of pressure injuries – but rather surface injuries
  - Can exacerbate existing skin breakdown
- Skin Microclimate (Heat and humidity)

Pathways of Development

- Pressure
- Shear
Extrinsic Risks Affect the Pathway

Temperature → Shear → Pressure → Moisture → Friction

Extrinsic Risks
- Pressure
- Shear
- Temperature
- Moisture

Pathway vs Pathology

What is the actual cause?

Etiology – Reviewing the Evidence

- Localized ischemia due to extrinsic forces
- Repertusion injury
- Impaired interstitial fluid flow & lymphatic drainage
- Sustained cell deformation with increased loads

Localized Ischemia

- Prolonged occlusion or deformation of capillaries
- Limited blood flow – Decrease O\textsubscript{2} and nutrients
- Ischemia to cells
- Tissue necrosis
Sustained Cell Deformation With Increased Loads

- High compressive loading not only caused ischemia but also distorted the cells and caused tissue “strain” (damage)
- Stekelenburg in 2007 concluded:
  - “2 hours of compressive loading lead to irreversible damage whereas ischemic loading results in reversible tissue changes”
  - “Large deformation, in conjunction with ischemia, provides the main trigger for irreversible muscle damage.”

Research Results

- Levy et al. *Journal of Tissue Viability* 2014
- 57% greater immersion with air-cell-based cushion
- Additional immersion and envelopment of air-cell-based cushion reduces loading by factor of 10,000
- Reduction of internal tissue loads
- Small change on surface area has huge results internally

Product Assessment

Greater Immersion & Envelopment  Less Risk for Deformation
Ischemia
- Occlusion of blood
- Reduce oxygen
- Change in metabolism
- Accumulation of waste products
- Decrease in pH
- Cell death

Deformation
- Deformation of cells
- Cell membrane failure
- Cell permeability increases
- Disruption of the cytoskeleton
- Decrease in pH
- Cell death

Clinical Significance
- Internal damage occurs with deformation
- May not present as a DTI, but damage may be present
- Deformation occurs around bone not only directly over top bone
- If damage is present scarring can continue to occur without outward signs of wound
- With multiple episodes – internal scarring
  - Eventually less force may cause open wound

INCREASED RISK

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INCREASED RISK

Characteristics of a Good Cushion
- Sufficient immersion and envelopment
- Adjustability to the uniqueness of the individual at initial fitting
- Adaptability to movement and activities
- Adjustability to the individual throughout subsequent weeks, months and years
- Durability over time

Ayelet Levy, Naama Shoham, Kara Kopplin, Amit Gefen

Quantifying the Effect of Redistribution
- Immersion - Capability of a cushion to allow the body to sink into it
- Envelopment - Capability of cushion to deform around and encompass the body

Quantifying the Effect of Redistribution
- Magnitude - How much force is concentrated on the bony prominences
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Change over time influences deformation
Deformation around boney landmarks

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Miss-match between the altered anatomy and the fitted cushion

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Macro vs. Micro Changes

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**Take Home Message**

- Internal deformation causes damage – once presents as DTI it is too late
- Management of extrinsic risk is paramount
  - Earlier and better management of deformation
  - Not just about the skin, but muscle and fat too
- Cushions must be *adjustable* for the long term changes and *adaptable* to daily life
- .... *AND* durable enough to continue to protect for the life of the cushion

**On-line Assessment Info**

- MUST sign the sign-in sheet
  - No sign in/out, NO CEUs will be issued
- On-line assessments *ONLY* active for 2 weeks!
  - If not complete within 2 weeks, NO CEUs will be issued
- Access via [www.roho.com](http://www.roho.com)
  - NEED case sensitive password to access
- Be ready to PRINT out certificate at the end of the on-line assessment!

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**Click on This Event**
Thank you! Questions?
Jennith.Bernstein@permobil.com

Password: dvE5e

Password is case sensitive