Update on Deep Tissue Injury

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History of Deep Tissue Injury

- Ulcers could erupt from intact skin (Paget, 1874)
- May be purple or yellow from extravasation of blood. The deeper tissues die, muscles, bones. Sloughing follows in the skin and fat and the place is empty (Paget, 1874)
- Ulcers that started in muscle were malignant (Groth, 1942)
- Closed pressure ulcers (Shea, 1975)
- Clinical records of “purple” pressure ulcers, bruises over intact skin, cautery burns, evolving full-thickness ulcer

Deep Tissue Injury Definition

- 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.

Deep Tissue Injury Description

- The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue.
- 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.

Time to Develop Pressure Ulcers

- Kozlak’s model shows ulcers developing in 2 hours at 600 mmHg pressure
- And ulcers developing after 10 hours at 200 mg Hg pressure
- Are these ulcers different?
Pathogenesis: An inside out pressure ulcer?

- Is the progression of a stage II ulcer always potentially a stage IV?
- Or are there 3 distinct possibilities?
  - Superficial pressure and/or microclimate leading to stage I and II
  - Ischemia leading to stage I to IV
  - Deep pressure with muscle cell damage leading to stage III and IV

Zones of infarct, ischemia and injury?

- Area sustaining highest pressures is infarcted
- Surrounded by rings of ischemic and injured tissue that is resuable

Reperfusion Injury: No Flow-Flow

- Cellular Changes with Tissue Injury
  - Cellular injury initiates a cascade of inflammatory responses including free radical production.
  - Normally "mopped up" with antioxidants
  - This process is likely overwhelmed in large injuries

Background

- Epidemiology (Vangilder N = 10,728)
  - sDTI's are likely to be facility acquired
    - 9.5% of all ulcers identified are sDTI's
    - 13.4% of FA ulcers are sDTI's
  - sDTI's are more common in high acuity settings
    - ICU (14% of all ulcers & 20% of FA ulcers)
    - LTAC (10% of all ulcers & 18% of FA ulcers)

DTI Incidence

- Increasing reported incidence to 9% of observed ulcers
  - Increased education
- More prevalent than stage III and IV ulcers
- Anatomic locations
  - Heel = 41%
  - Sacrum = 19%
  - Buttocks = 13%
Natural history of purple pressure ulcers

- 82 cases of patients who sued over severe pressure ulcers that began as purple skin
  - Period of “confinement” to a hard surface or limited turning on a support surface preceded purple skin by around 48 hours
  - Purple skin on buttocks and heels developed thin blisters about 24-48 hours later, then became necrotic or blood blistered
  - Population at risk
    - Wide variation in age (ages 24-98)
    - 70% emergent admissions to hospital

Natural history—prospective—6 NC facilities (Richbourg)

- Patient variables
  - Prealb 10.9, alb 2.2, Hgb 9.7
  - 83.8% on group 2 surface
  - 65% AC use
- Outcomes
  - 5% of sDTI naturally resolve
  - 68% remained DTI
  - 28% became stage III/IV or unstageable
  - Poorer outcomes with smoking, OR

Natural History of sDTI in Acute Care

- 200 cases of sDTI reported to wound service
  - Wide age range (14-102 years)
  - 70% of sDTI Present on Admission
  - Pneumonia, Failure to Thrive and Sepsis common
  - Anemia common
  - Progression
    - 73.5% intact purple initially
    - 65.5% blistered or denuded at 72 hrs
    - 46% necrotic at day 7

Natural history (Sullivan, 2013)

- Retrospective review of 77 pts with DTI
- Followed from 1 day to 14 weeks
- Patient factors
  - Age range 32-91 years
  - CAD, DM, Immobility, ICU time, incontinence
  - Surgery in past 7 days
- Outcomes
  - 40% sacrum/coccyx, 29% heels, 7% buttocks
  - 90% purple or maroon initially, 24% remained so
  - 9% deteriorated

Photograph of “typical” sDTI

Diagnosis of DTI

- Usually by inspection
  - Issues with misidentification
- Ultrasound
  - Aoi, PRS, 2009
- Elevated CPK
  - False positives
Diagnosis of DTI with Biomarkers (Dan Bader)

- Sweat and Tissue CO2 higher in loaded tissue
  - From Pollack, 1993, 1997; Knight 2001; Bader, 2005
- Cytokines – Interleukin 1 higher in loaded tissue
  - From Cornelissen, 2009
- Collagen breakdown products released in urine in SCI patients
  - From Rodriguez and Claus-Walker, 1988

Prevention of DTI

- Little published work in prevention of DTI
  - Low Air Loss-Microclimate Management Mattress
  - Preventive Dressings
- Any program of pressure ulcer prevention would decrease DTIs

Implanted electrodes to target paralyzed muscles (Dan Bader)

- Analyses Interface Pressures and stimulates gluteal muscles
- May provide a method for pressure relief in paraplegics

Clinical Presentation is Unique

- Location
  - Occur on tissue subjected to pressure
    - not always bony prominences
- Timing
  - Color change is delayed sometimes after pressure is relieved
- Color
  - Purple or maroon, not red
- Rate of deterioration
  - Rapid, becoming full thickness quickly

Time Frame between Injury and Visible Presentation

- An event of confinement always preceded the first notation of purple skin by 48 hours
- Within 48 hours of the identification of purple skin, blisters were noted from epidermal sloughing
  - Thin blisters, not fluid filled
  - Often called “Stage II” pressure ulcers

Determining surface that led to injury

- Examine location of current DTI
  - Buttocks – patient was flat
  - Sacrum – HOB was up
  - Heels – feet were on mattress
  - Bottom of the foot – feet were pressing against something – footboard?
  - Can develop under medical devices
DTI Following 12 Hour Operation

DTI in Septic Patient, Unstable for 48 hours

Delay between injury and visible presentation
- Time delay presents problem when
  - Patient has moved between settings
  - Patient has been in OR, ER, Cath lab
- Difficult to have conclusive root cause analysis

Epidermal loss in black skin
- Epidermal loss with skin slippage
- Red blistered skin visible
- Commonly called a skin tear

Distinguish from Skin Tears
- Skin flap of blistered epidermis mimics skin tear
- Seldom is there a history of trauma in that body area

Distinguish from Ecchymosis
- Bruising with a history of trauma
- Can be difficult to distinguish from deep tissue injury in the same area
- Consider Morel-Lavalle lesions
Distinguish DTI from Hematoma
- History of trauma
- Fractured pelvis with pelvic hematoma
- May lead to purple skin and epidermal slough
- Morel-Lavallee lesions (internal degloving injury) with pelvic trauma

Degloving Injury of the Leg

Distinguish from Ischemic (Levophed) tissue changes
- Seen with prolonged hypotension and Levophed use
- Peripheral tissue only, not subjected to pressure

Distinguish from Venous Engorgement
- Patients with poor perfusion may develop purple skin in dependent tissues
- Purple color changes with motion

Distinguish from Kennedy Terminal Ulcer
- Rapidly developing ulcer appearing about 48 hours prior to death
- Etiology unknown
  - Low perfusion during which the skin cannot recover from usual pressures?
  - Skin infarction?
  - Variant of DTI?

Finding Cases of sDTI
- Look at risk profile
  - Confinement for more than 3 hours
    - OR, cath lab cases
    - History of being down at the scene
    - Unable to turn in ICU
    - Leg immobile
      - Total hip, total knee
      - Fractured hip
    - Leg numb
      - Stroke, DM
- Look at skin in areas subjected to pressure
  - Ask high risk patient about pain in heels, buttocks, tailbone
  - Look for purple or maroon nonblanchable skin
Reporting DTI Cases

- If present on admission, document the evolution of DTI
  - Risk profile of admission
  - Purple skin 48 hours later
  - Blistered skin following

- Coders have been advised to label this wound as unstageable because there is no ICD-9 code for DTI

- Same process with hospital acquired

Recommended Treatment

- Relieve pressure completely from areas likely to have DTI
  - Side to side turning
  - Support surfaces
  - Heels in boots

- Relieve pressure from all purple skin
- Maintain perfusion

- Building evidence for Noncontact Low Freq Ultrasound
  - Honaker Study
  - Hanada research on vibration

- No evidence to support:
  - Xenaderm
  - Early debridement
  - HBO

Improvement of DTI with Noncontact Ultrasound

- Retrospective chart review; March 09 - March 10
  - 127 sDTI’s
    - 63 were treated with SoC only
    - 64 with SoC and MIST®

- Inclusion consisted of patients identified with sDTI with in 4-5 days of onset.
  - All patient received standard of care
  - Treatment group received MIST and standard of care

Honaker, 2011

Two Extremes of Koziak’s Pressure Time Curve?

Evolution of DTI versus superficial ulcers

Consensus Questions with High Levels of Agreement

- Statements on Present on Admission
  - A sDTI visible on admission is not a facility/agency acquired pressure ulcer
    - 98% Agree (N = 101/103)
  - The beginning of sDTI can precede admission to a health care facility and may not be visible on admission.
    - 97.6% Agree (N = 122/125)
Consensus on POA and Documentation

- Given that the standard of care was met, the evolution of an sDTI into a full thickness pressure ulcer, which was present on admission, is NOT evidence of inadequate care
  - 95.6% Agree (N = 110/115)
- The electronic medical record should include the ability to document the evolution of sDTI
  - 94.5% Agree (N = 105/111)

Consensus on Patient Factors

- A history of pressure and/or shear in the injured tissue makes the diagnosis of sDTI more likely
  - 93% Agree (N = 94/101)
- Distinguishing an sDTI from other causes of purple/maroon tissue is a complex process.
  - 93.3% Agree (N = 112/120)

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Consensus on Patient Factors

- Perioperative pressure ulcers classified as sDTI may occur after prolonged exposure to pressure during surgical procedures.
  - 98% Agree (N = 97/100)
- An sDTI can occur under a medical device in contact with the skin.
  - 98.3% Agree (N = 119/121)
  - This item had the highest level of agreement of all statements.
  - Please find a downloadable poster at npuap.org

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Treatment of DTI Consensus Items

- Support surfaces, higher than Group 1, are recommended for the treatment of sDTI (truncal, pelvic, trochanteric locations) in the home setting.
  - 83.8% Agree (83/99)

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Outcomes of DTI Consensus Item

- Some sDTI can resolve without full thickness tissue loss
  - 82.4% Agree (N = 89/108)
  - This item had the lowest level of agreement of all statements.

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Consensus Items without Agreement

- An sDTI that presents in less than ____ hours of the first admission to a health care setting is likely unavoidable.
  - 24 hours (N = 18)
  - 48 hours (N = 31)
  - 72 hours (N = 30)
  - No one knows (N = 36)
Consensus Items without Agreement

- In persons with dark skin tones, an sDTI presents with a color change in the skin.
  - 62.1% Agree (N = 51/82)
  - Considerable discussion on this point including photographs of darkly pigmented patients with sDTI
  - 62.1% Agree (N = 51/82)
- The color variation in sDTI (maroon vs purple) predicts the likelihood of recovery.
  - 22.3% Agree (25/112)

Consensus Items without Agreement

- Deep tissue injury is an etiology of pressure ulcers, not a stage
  - 59% Agree (N = 59/99)
- Deep tissue injury should have its own phases
  - 1 = intact purple skin
  - 2 = blistered
  - 3 = loss of dermis
  - 4 = necrotic (full thickness)
  - 75% Agree (N = 75/101)

New Studies in Pressure Ulcer Prevention

- 5 layer dressings prevent sacral pressure ulcers in high risk patients
  - Santamaria RCT
  - Kawoles RCT
- 4 layer dressing prevents heel ulcers in high risk patients
  - Santamaria RCT
- Turning Q 2, 3, 4 in LTCs led to same number of pressure ulcers on viscoelastic foam
  - Bergstrom RTC

Questions?