The Correlation Between Ultrasound Findings and Clinical Assessment of Pressure-Related Ulcers: Is the Extent of Injury Greater Than What is Predicted?

Kristen Aliano MD; Christopher Low MD; Steve Stavrides PA-C; John Luchs MD; Thomas Davenport MD

Disclosure

K. Aliano, C. Low, S. Stavvides, J. Luchs, and T. Davenport

None of the authors have listed any financial interest/arrangement that would be considered a conflict of interest.

Background: Ultrasound and DTI

- Ultrasound (US) can be used for the early diagnosis of pressure wounds
- This could potentially prevent worsening of the injuries and better predict treatment options
- Yabunaka et al. (2009) found that "high-resolution ultrasound may be able to detect pressure ulcers before clinical signs emerge" through the identification of edema, which is considered to be an early indicator of tissue injury
Background: DTI

- Studies have found evidence of deep tissue injury in Stage I and Stage II ulcers
- Stage I and Stage II wounds most commonly occur in the sacro-coccygeal region

Objective and Hypothesis

- To use ultrasound in the assessment of deep tissue injury in Stage I and Stage II ulcers and to assess the deep tissue in wounds classified as suspected deep tissue injury (sDTI)
- We postulate that deep tissue injury is present in superficial appearing ulcers and in suspected deep tissue injury.

Methods

- Upon admission, patients with sacral ulcers were classified according to the NPUAP staging system
- Patients with Stage III, Stage IV, and unstageable wounds were excluded so that only people with Stage I, Stage II, and sDTI lesions were included
Methods

➢ High-frequency (12MHz) U/S was then performed over the affected areas to look for evidence of deep tissue injury

➢ Abnormal U/S findings indicative of deep tissue injury included:
  ➢ Loss of dermal-epidermal interface
  ➢ Subcutaneous hypoechoic lesions
  ➢ Heterogeneous hypoechogeticity of deep muscle

➢ Patients with at least one of these findings were classified as having deep tissue injury

Results

➢ Over a three-month period, 32 patients were admitted to the hospital with a sacral ulcer present upon admission

➢ 20 patients had Stage I, Stage II, or sDTI wounds:
  ➢ Stage I-8 patients
  ➢ Stage II-4 patients
  ➢ sDTI-8 patients

Results: Normal Control U/S Findings

In a healthy patient, ultrasound of the sacral spine shows a crisp dermoepidermal interface and no hypoechogeticity of the subcutaneous tissue or deep muscle.
**Results: Stage I U/S Findings**

The ultrasound image shows a hypoechoic lesion and a disrupted dermoepidermal interface.

**Results: Stage II U/S Findings**

The ultrasound image shows hypoechoic lesions and a loss of dermoepidermal interface.

**Results: sDTI U/S Findings**

In this patient, the ultrasound images show disruption of fascial planes and hypoechogenicity in the muscle and subcutaneous tissue.
### Results

#### Stage I
- Percent with Disruption of Interface: 62.5
- Percent with Subcutaneous Hypoechoic Lesions: 87.5
- Percent with Decreased Echogenicity in Muscle: 37.5

#### Stage II
- Percent with Disruption of Interface: 100
- Percent with Subcutaneous Hypoechoic Lesions: 75
- Percent with Decreased Echogenicity in Muscle: 0

#### sDTI
- Percent with Disruption of Interface: 100
- Percent with Subcutaneous Hypoechoic Lesions: 100
- Percent with Decreased Echogenicity in Muscle: 62.5

### Discussion

- Previous studies have suggested that all ulcers that appear superficial have an element of DTI
- Pressure wounds can develop in a “bottom-up” fashion
Berlowitz and Brienza (2007) suggested that deep tissues are more likely to be deleteriously affected by applied pressure than the more superficial skin.

As tissue is exposed to mechanical stress over time, there is an increase in pro-inflammatory humoral mediators even before tissue damage is seen.

The results confirm our hypothesis that Stage I and Stage II ulcers have a deeper extent of injury than seen on clinical examination.

Non-blanching erythema may be the first overt sign of underlying tissue injury.

Using ultrasound to look for evidence of deep tissue injury in individuals with Stage I and Stage II lesions could enable clinicians to institute more aggressive treatment at an earlier point in time.

We also found that ultrasound was also an excellent confirmatory test for those patients who were already identified as having sDTI wounds.

Our study confirms the results of previous experiments that show that pressure sores may develop with initial deep tissue damage.
Conclusion

- Ultrasound is a good screening tool that can be used for the assessment of deep tissue injury in Stage I and Stage II wounds.
- Deeper tissue injury is present in many pressure wounds that appear clinically superficial.

Thank You!