The Wound Balance Concept:

Leveraging The BIOMES^{SM} Tool
for Early Recognition of Chronic Wounds

Supported by an educational grant from HARTMANN USA, Inc. and PAUL HARTMANN AG

Faculty

- **Laura Swoboda, DNP, APNP, FNP-C, FNP-BC, CWOCN-AP, WOCNF**
  Milwaukee, WI

- **Trent Brookshier, DPM**
  Owner, North Park Podiatry (Private Practice)
  Attending Podiatric Surgeon, Scripps Mercy Hospital
  San Diego, CA

Faculty Disclosures

- **Laura Swoboda, DNP, APNP, FNP-C, FNP-BC, CWOCN-AP, WOCNF**
  Consultant: Hartmann USA

- **Trent Brookshier, DPM**
  Consultant: Hartmann USA
  Speakers Bureau: MiMedx

Disclosures

- The faculty have been informed of their responsibility to disclose to the audience if they will be discussing off-label or investigational use(s) of drugs, products, and/or devices (any use not approved by the U.S. Food and Drug Administration)
  - Applicable CME staff have no relationships to disclose relating to the subject matter of this activity
  - This activity has been independently reviewed for balance
- This continuing medical education activity may include device or medicine brand names for participant clarity purposes only; no product promotions or recommendations should be inferred

Learning Objectives

- Recognize the BIOMES^{SM} Tool acronym as a resource for determining wound risk and wound classification
- Identify the impact of each element of the BIOMES^{SM} Tool on the patient's healing process and the importance of early recognition
- Explore how the BIOMES^{SM} Tool ties into the concept of "balancing the wound environment," a critical principle in wound care that focuses on creating and maintaining an optimal environment for healing
- Examine the goals of balancing the wound environment — preventing infection, promoting tissue regeneration, and facilitating faster recovery
- Explore, via a case-based format, appropriate dressing selection, treatment options, and techniques to maintain wound balance

BIOMES = Blood flow, Infection control, Offloading, Metabolic/comorbidities, Exudate/moisture/bioburden, Social/economic barriers.

Q&A

Questions are welcomed

Submit your questions anytime via the question box

The BIOMES^{SM} Tool and Wound Balance

Trent Brookshier, DPM
Owner, North Park Podiatry (Private Practice)
Attending Podiatric Surgeon, Scripps Mercy Hospital
San Diego, CA

Increasing Prevalence of Non-Healing Wounds

- The longer a patient has a wound, the higher the chance is for amputation or life-threatening septic event
- Substantial economic burden
- 16.3% of Medicare beneficiaries have hard-to-heal wounds
  - Total cost of care exceeds $22 billion

Feight J, et al. *J Wound Care*. 2023;32(11):720-726. Tettelbach WH, et al. *J Wound Care*. 2022;31(Sup2):S10-S31. Lindholm C, Searle R. *Int Wound J.* 2016;13 Suppl 2(Suppl 2):5-15.

Polling Question

Is there a way to determine which wounds are likely to be *non-healing*?

1. Yes
2. No

Initial Wound Evaluations and Assessments

Often performed by:

- Urgent care
- Nursing homes
- Emergency room / responders
- General medicine / PCPs

Often unfamiliar with specific wound care scoring systems:

- The Wagner Scale
- UT Wound Classification System
- Bates-Jensen Wound Assessment Tool
- TIMERS Checklist
- PUSH Tool

UT = University of Texas; TIMERS = Tissue, Infection/Inflammation, Moisture, Edge, Repair/Regeneration, Social; PUSH = Pressure Ulcer Scale for Healing.

Takahara M, et al. *Ann Vasc Dis*. 2020;13(1):56-62.

Polling Question

Do you currently use a scoring system when first observing a wound on a patient?

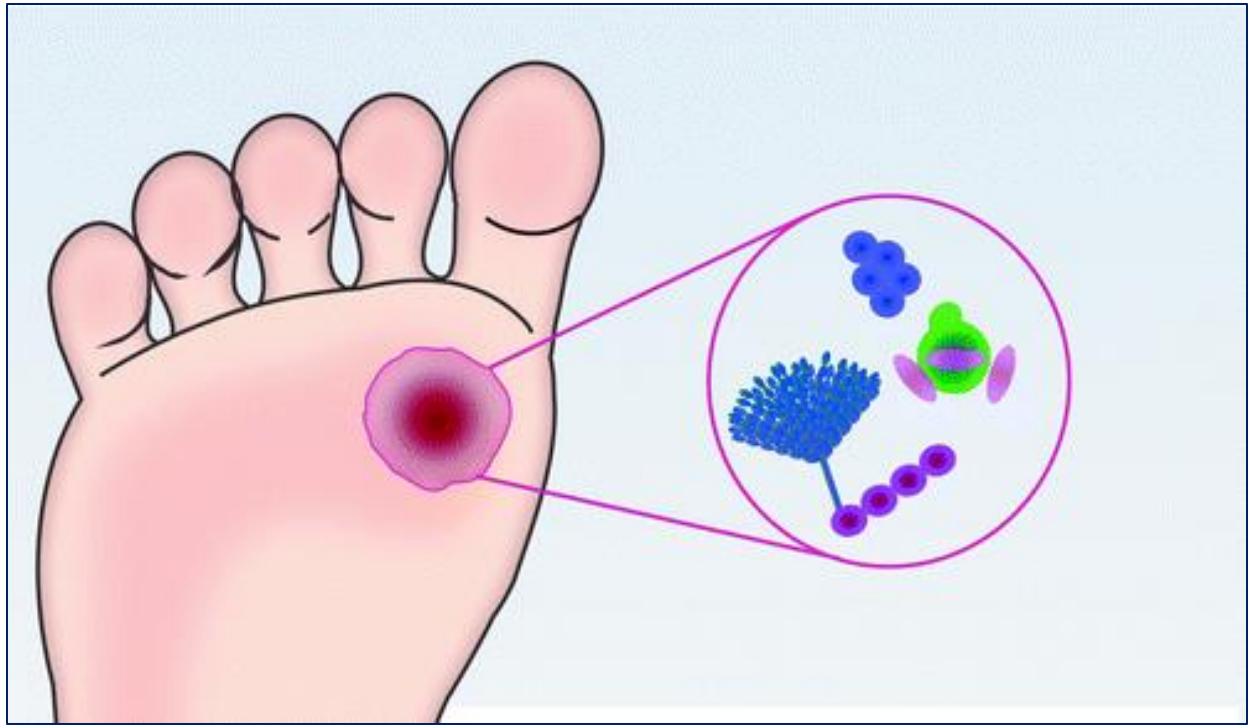
1. Yes
2. No
3. It depends on the type of wound

What I am trying to avoid…

Why am I just now getting a wound consult for this patient?

Wounds Are Really Just Microbiomes

- Microorganisms
  - Bacteria, fungi, viruses, etc.
- Our skin is our best defense
- Address these microbiomes and identify the red flags to wound healing



The BIOMES^{SM} Tool: A New Tool for Screening

Barriers to Wound Healing

- **B** Blood Flow ☐
- **I** Infection/Bioburden ☐
- **O** Offloading/Overloading ☐
- **M** Metabolic/Morbidities ☐
- **E** Exudate/Edema ☐
- **S** Social/Economic ☐

Total BIOMES^{SM} Tool Score: ☐

How to Use the BIOMES^{SM} Tool

1. Assess each component of the BIOMES^{SM} Tool
2. Check each component present
3. Add up the number of barriers present
4. Follow recommendations based on the BIOMES^{SM} Tool Risk Score

B = Blood Flow

- No flow = no healing
- Check: Pulses, capillary refill, skin appearance, ABI, rubor dependency, etc.
- Cause: PAD (most common), thrombus, cysts, trauma, vasospasms
- Lifestyle: Sedentary, smoking, vaping
- Potential interventions: Lifestyle changes, medication, compression, elevation, vascular procedures, SURGERY

ABI = ankle-brachial index; PAD = peripheral arterial disease.

I = Infection / Bioburden

- All wounds have flora; the need for antimicrobial intervention depends on the number and type of microbe (biopsy/culture)
- Local vs systemic infection
- Chronic vs acute emergency
- Biofilm
- Debridement

Punjataewakupt A, et al. *Eur J Clin Microbiol Infect Dis*. 2019;38(1):39-54. Nusbaum AG, et al. *Skin Therapy Lett*. 2012;17(7):1-5. Høiby N, et al. *Clin Microbiol Infect.* 2015;21 Suppl 1:S1-25. Mori Y, et al. *Wound Repair Regen*. 2019;27(5):540-547.

O = Offloading/Overloading

- Pressure injuries; bed sores
- Repeated trauma, tissue necrosis
- DFUs and neuropathy
  - Motor neuropathy
  - Sensory
  - Vascular component
- Biomechanics of stance vs gait

DFU = diabetic foot ulcer.

Firnhaber JM, Powell CS. *Am Fam Physician*. 2019;99(6):362-369. Bandyk DF. *Semin Vasc Surg*. 2018;31(2-4):43-48. Faglia E. *Int J Low Extrem Wounds.* 2011;10(3):152-166.

O = Offloading/Overloading

Potential Treatment Options

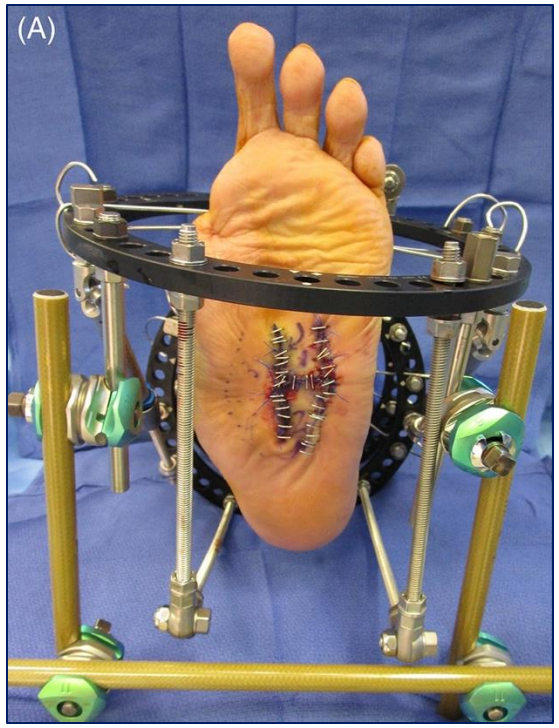
- Diabetic shoes
- Custom orthotics
- Total contact cast
- External fixation
- Surgery

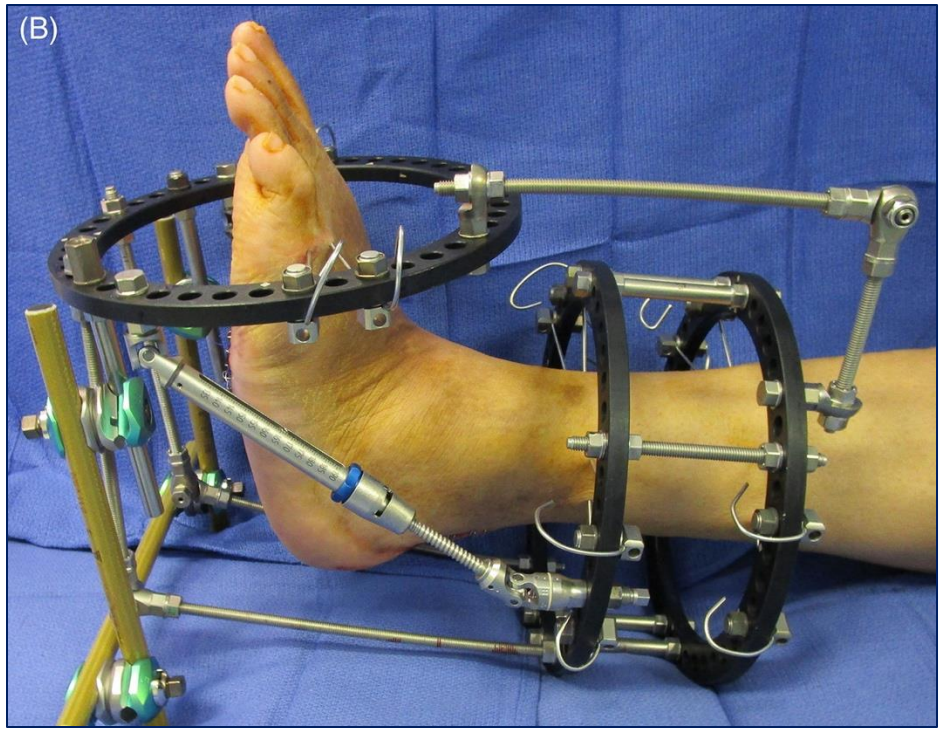
Panel EPUA, Panel NPIA, Alliance PPPI. *Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline*. 2019.

O = Offloading/Overloading

Potential Treatment Options

- External fixation
- Surgery





Panel EPUA, Panel NPIA, Alliance PPPI. *Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline*. 2019.

M = Metabolic / Morbidities

REMEMBER:

Treat the WHOLE patient… not just the hole in the patient

- DM2 (most common)
- End-stage renal disease (ESRD,CKD); PVD
- A1c less than 7%
- Glycosuria above 180 mg/dL

DM2 = type 2 diabetes; ESRD = end-stage renal disease; CKD = chronic kidney disease; PVD = peripheral vascular disease.

Dasari N, et al. *Semin Plast Surg*. 2021;35(3):153-158. Hu SC, Lan CE. *J Dermatol Sci*. 2016;84(2):121-127. Rosenberg CS. *Nurs Clin North Am*. 1990;25(1):247-261.

M = Metabolic / Morbidities

- Adequate protein vs malnutrition
- Obesity
- Autoimmune
  - Lupus
  - Pyoderma gangrenosum
  - Pemphigoid
  - Drug-induced hypersensitivity syndrome

Characteristics of an Atypical Wound

- Unusual location (eg, calf, thigh, abdomen)
- Unusual age of patient (eg, a necrotic wound on the toe of a young person
- Asymmetrical lesion shape
- Granulation that extends over the wound edge
- Exuberant granulation or callus
- Friable granulation tissue, as seen on either malignant or infected wounds
- Purple-red border (violaceous), suggestive of pyoderma gangrenosum
- Ulcer in the center of pigmented lesion
- Hx of repeated trauma or burn (possible SCC)
- Rolled out edges (if on the lower leg, suggestive of combined arterial/venous insufficiency)
- Fungating growth (suggestive of malignancy)
- Hx of radiation therapy
- No obvious diagnosis with failure to respond to standard care

SCC = squamous cell carcinoma.

Guo S, Dipietro LA. *J Dent Res*. 2010;89(3):219-29. Hirt PA, et al. *J Am Acad Dermatol.* 2019;81(5):1037-1057.

E = Exudate / Edema

- Wound exudate
  - Serous
  - Sanguineous
  - Purulent
- Contains matrix metalloproteinases (MMPs), which contribute to delayed healing
- Some treatment options include
  - Superabsorbent polymer (SAP) dressings
  - Compressive dressings

MMP = matrix metalloproteinase; SAP = superabsorbent polymer.

Moore Z, Strapp H. *Br J Nurs*. 2015;24(15):S12, S14-17.

S = Social / Economic Burdens

- Stress, smoking, vaping, alcohol
- Living situation
  - Family support
  - Skilled nursing facility (SNF)
  - Living alone
  - Stairs
- Access to care, transportation

SNF = skilled nursing facility.

Feeser VR, et al. *Wound Repair Regen*. 2009;17(5):758-61. Hom DB, Davis ME. *Facial Plast Surg Clin North Am*. 2023;31(2):171-181.

Why See a Wound Specialist?

- Studies show better healing with a multidisciplinary wound care service / specialist
- A study (Takahara, et al.) found that patients with critical limb threatening ischemia (CLTI) often had wounds 1-3 mos before referral to vascular specialist
- Lack of resources
  - Cellular tissue-based products (CTPs)
  - Advanced dressings, wound vacs
  - Vaporous hyperoxia therapy (VHT), debridement tools
  - Vascular intervention
  - In-office ABI, A1c
  - In-office imaging (fluoro, ultrasound, xray, etc.)

CLTI = critical limb-threatening ischemia; CTP = cellular tissue-based product; VHT = vaporous hyperoxia therapy.

Rivolo M, Staines K. *J Wound Care*. 2021;30(9):685-692. Takahara M, et al. *Ann Vasc Dis*. 25 2020;13(1):56-62. Akiki RK, Mehrzad R. *J Am Board Fam Med*. 2020;33(5):799-808.

How to Use the BIOMES℠ Tool

Risk Assessment Guidance

0 BIOMES℠	1 BIOMES℠	≥2 BIOMES℠
Low Risk Continue to assess	**Moderate Risk** Consider referral to wound specialist	**High Risk** Do not delay Refer to wound specialist now

2 wks without improvement: Refer to wound specialist

Follow Wound Balance recommendations for early intervention

Case #1

- 70y Male
- PMH: DM2
- Chronic wound x8 mos
- Previous treatment: Regular debridements with dry dressings at SNF

Left foot


Right foot

Case #1

New plan on arrival at our office:

- ABI to assess blood flow
- The BIOMES^{SM} Tool score
  - High risk: 2^{+}, abnormal ABI, DM2
- Debride weekly for Infection/Bioburden
- Zetuvit® (multilayer silicone SAP dressing), gauze, and compression dressing to address Exudate/Edema
- When ready, skin substitute was applied
  - PalinGen® Membrane (human allograft processed from amniotic tissue)

Left foot

ANKLE / BRACHIAL INDICES

NC = NON-COMPRESSIBLE

RIGHT ANKLE BRACHIAL INDEX	1.47	LEFT ANKLE BRACHIAL INDEX	1.38

RIGHT ARM

SYSTOLIC	117	mmHg
DIASTOLIC	59	mmHg

LEFT ARM

SYSTOLIC	115	mmHg
DIASTOLIC	59	mmHg

RIGHT ANKLE

RIGHT POSTERIOR TIBIAL ARTERY
SYSTOLIC P. 172 mmHg

RIGHT DORSALIS PEDIS ARTERY
SYSTOLIC P. 173 mmHg

LEFT ANKLE

LEFT POSTERIOR TIBIAL ARTERY
SYSTOLIC P. 167 mmHg

LEFT DORSALIS PEDIS ARTERY
SYSTOLIC P. 162 mmHg

ABI RANGES 1.4 1.3 1.0 0.9 0.8 0.6

TOE BRACHIAL INDICES

RIGHT TOE BRACHIAL INDEX	0.46	LEFT TOE BRACHIAL INDEX	0.46

RIGHT TOE

SYSTOLIC P.	53	mmHg
RIGHT TOE SPO2	96	%
RIGHT PI %	2.3	%

LEFT TOE

SYSTOLIC P.	53	mmHg
LEFT TOE SPO2	96	%
LEFT PI %	3.3	%

TBI RANGES 0.65 0.5 0.4 0.2

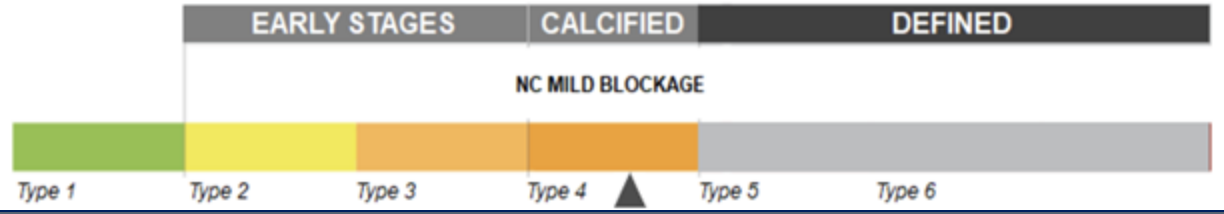
LOWER EXTREMITY BLOOD FLOW

RIGHT VASOMOTION 19 mV/min

LEFT VASOMOTION 19 mV/min

VASOMOTION RANGES 35 25 15

PERIPHERAL ARTERY DISEASE ASSESSMENT (PAD) CHART



Case #1

Case #2

- 71y Female, 2^{+} yr chronic wound
- NON-diabetic, Charcot neuroarthropathy
  (a chronic, devastating, destructive disease of the bone structure characterized by painful or painless bone and joint destruction in limbs that have lost sensory innervation)
- Patient had difficulty with insurance and getting to the office for wound checks
- What is the BIOMES^{SM} Tool score?

2+, Offloading burden and access to care

Clinical Pearls

- Use the new BIOMES℠ tool to identify if a wound should be sent to a specialist / dedicated wound team
  - Don’t delay; refer today!

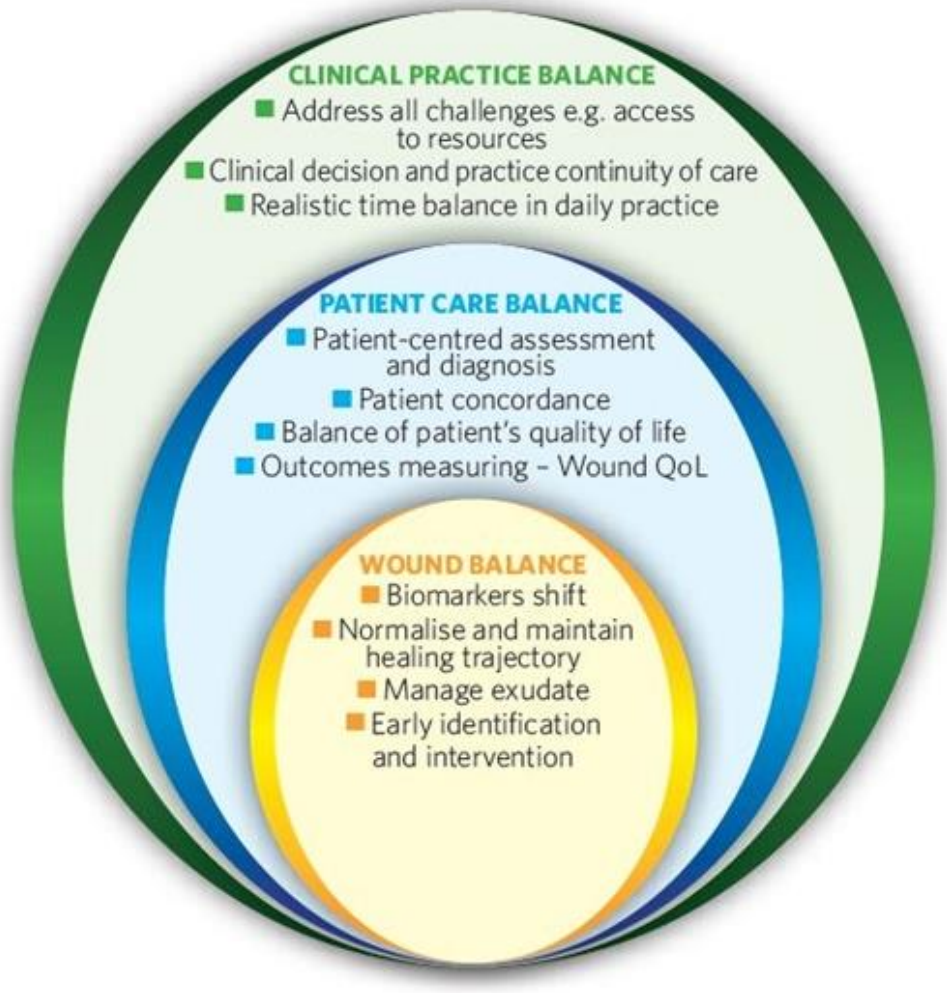
- If you are a specialist in wound healing, use this tool to double-check your work and to remind you of what could be utilized to keep healing wounds for each patient, each day

The BIOMES^{SM} Tool and Wound Balance

Laura Swoboda, DNP, APNP, FNP-C, FNP-BC, CWOCN-AP, WOCNF
Milwaukee, WI

The BIOMES^{SM} Tool and Balancing the Wound Environment

- The BIOMES^{SM} Tool is along the spectrum of tools balancing the environments that impact wound healing
- Wound Balance includes 3 layers
  - Wound
  - Patient
  - Clinical
- Wound Balance: A critical principle in wound care that focuses on creating and maintaining an optimal environment for healing



The BIOMES℠ Tool screens for many factors that inhibit that environment

Wound balance creates an optimum healing environment

The BIOMES^{SM} Tool

B – Blood Flow

I – Infection Control

O – Offloading

M – Metabolic/Comorbidities

E – Exudate/Moisture/Bioburden

S – Social/Economic Barriers

Wound Balance

- Wound microenvironment: BIE
- Patient factors: OMS
- Systemic/clinic/administrative factors: MS

The BIOMES^{SM} Tool and Balancing the Wound Environment

Biomarkers: Inflammatory markers that shift during wound phases along the healing trajectory

Inflammatory marker examples

- CRP
- ESR
- Procalcitonin
- Ferritin

Signs of dysfunctional inflammation

- Unhealthy granulation
- Lack of granulation
- Erythema
- Pain
- Increased drainage
- Lack of healing

Polling Question

Gauze dysregulates the wound microenvironment through which pathway?

1. Promotion of local hypothermia
2. Fomentation of inflammation
3. Bioburden remaining against the wound bed
4. All of the above

Polling Question

Gauze dysregulates the wound microenvironment through which pathway?

1. Promotion of local hypothermia
2. Fomentation of inflammation
3. Bioburden remaining against the wound bed
4. All of the above

The BIOMES^{SM} Tool and Balancing the Wound Environment

Patient-clinician partnership in achieving healing outcomes, which includes improving quality of life

Goals of Balancing the Wound Microenvironment

- Prevent infection
- Promote tissue regeneration
- Facilitate faster recovery

Case Exemplar

85y Female; Traumatic scalp wound w/hematoma

- 3.3x2.3x0.2; undermines 0.1cm at 9 o’clock
- PMHx significant for HLD, A-fib, CAD, PE, morbid obesity, COVID myopathy, peripheral polyneuropathy
- Wound is >4wks old; fell at home and developed hematoma, which ulcerated

HLD = hyperlipidemia; CAD = coronary artery disease; PE = pulmonary embolism.

Wound Clinic Referral, Improvement with Wound Balance

- Blood flow is too good!
- Infection control
- Offloading
- Metabolic/Comorbidities
- Exudate
- S (Cannot reach, wants to shower)

Wound Clinic Referral: Improvement with Wound Balance

PLAN

Wound Treatment Recommendations

- Cleanse wounds, periwound, and entire extremity with soap and water
- Apply hypochlorous acid and soak for 2-3 min
- Ensure periwound is completely dry; apply skin protectant to periwound
- Apply antimicrobial collagen to wound bed
- Apply super absorber PRN for drainage
- Secure with hydrocolloid
- Assess wound and provide care weekly and PRN
- Recommend adhesive remover to remove bandage due to hair
- Home health

Wound Clinic Referral, Improvement with Wound Balance

Wound Balance

- Wound
- Patient
- Systemic

2-wk follow-up

1.5x1.0.1cm 1.5cm^2 90%

Polling Question

Which image shows the healthiest granulation tissue?

1

2

3

?

2

61y Female, Sacral PI Stage 4, Paraplegia from MVA >25 yrs

- Failed outpatient NPWT, concerns for unskilled applications leading to dressing failure
- Smoking status
- Currently on bleach solution wet to dry

- B – Blood Flow
- I – Infection Control
- O – Overloading
- M – Metabolic/Comorbidities
- E – Exudate/Moisture/Bioburden
- S – Social/Economic Barriers

Wound Balance

- Wound microenvironment
- Patient factors
- Systemic, clinic, administrative factors

Clinical Pearls

- The BIOMES^{SM} Tool screens for factors associated with delayed wound healing to quickly identify patients who must be referred to a wound center
- Wound Balance addresses the factors within the BIOMES^{SM} Tool
- All wounds benefit from evidence-based wound bed preparation

Thank You!

Questions are welcomed.

Submit your questions via the question box.