The Lessons of War: Turning Medical Data into Clinical Decisions

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Nothing to disclose

Combat-related Wounds May Have Different Clinical Outcomes


Bilateral lower extremity amputation (BLA)
LLE
RLE
BLA + Critical colonization (CC)
LLE
RLE
BLA + CC + Dehiscence
LLE
RLE
BLA + CC + Heterotopic ossification
LLE
RLE
BLA + CC + Dehiscence + Heterotopic ossification
LLE
RLE

Timing of regenerative medicine
Treatment of complications
Assess systemic response
Personalized treatment
Assess bioburden
VTE prophylaxis and therapy
Return to duty
Assess tissue viability
Immediate response to injury
Debridement and Critical Care
Acute Resuscitation
Regenerative Medicine & Rehabilitation
Mass Transfusion Protocol
Mass Transfusion Protocol
Invasive Fungal Infection
Invasive Fungal Infection
Physiologic Monitoring
Physiologic Monitoring
Venous Thrombo-Embolism
Venous Thrombo-Embolism
Traumatic Brain Injury
Traumatic Brain Injury
Heterotopic Ossification
Heterotopic Ossification
SC²i Clinical Decision Support Systems (CDSS)
Calcaneus Fracture Tool
Wound Closure

Sample Collection

Serum:
- Cytokines
- Chemokines
- Proteases
- 2D Gels (UC-Davis)
- FACS, PAXgene

Tissue biopsy:
- Wound healing associated genes
- Osteogenesis
- Pathogen specific PCR
- Pathogen Sequencing (LLNL/WRAIR)

Wound effluent:
- Cytokines
- Chemokines
- Proteases
- 2D Gels (UC-Davis)

Patient Demographics

n= 73 Patients, 116 Wounds, 399 surgical debridements
Machine Learning Methods

• Outcome: Wound Failure
  – Random Forest
    • Useful with many variables (features) and rare events.
    • Decision trees
  – Bayesian Belief Network
    • Useful with missing input data and rare events
    • Probabilistic relationships between features
  – Regression Analysis (LASSO)
    • Historical “gold” standard in medical literature

WounDX™: A Clinical Applicable Model

Civilian Trauma Is Not So Different

Civilian Trauma Is Not So Different

WounDX™ Model

- 19 year old male, injured by an improvised explosive device (IED) blast during the Operation Enduring Freedom (OEF) on May of 2010 sustaining:
  1- right pneumothorax,
  2- right thumb amputation,
  3- right transfemoral amputation,
  4- fractures of the right anterior maxillary wall, left medial malleolus, and left distal segments of the radius and ulna,
  5- soft tissue injuries in bilateral upper extremities and left lower extremity.

  – ACUTE RESUSCITATION 5 units of packed red blood cells (PRBC) and 6 units of fresh frozen plasma (FFP)
  – MEDDEVAC to the Landstuhl Regional Medical Center (LRMC), in Germany.
  – Debridement, VAC, Extubated.
  – MEDDEVAC to CONUS on POD4, to Walter Reed National Military Medical Center (WRNMC at the time).
First OR visit
5 days after injury

WoundDx model input variables:
1. Number of blood products received in the first 24h: 35
2. Number of blood products received at WRNMMC: 17
3. Serum Eotaxin: 51.6 pg/ml
4. Serum IL-1α: 25.7 pg/ml
5. Wound exudate IL-4: 8.01 pg/ml
6. Wound exudate IL-6: 107,000 pg/ml
7. Serum IL-7: 27.5 pg/ml
8. Serum MCP-1: 563 pg/ml
9. Use of Seroquel: No
10. Serum TNF-α: 0.621 pg/ml
11. Genitourinary trauma: No

Prediction of outcome:
Dehiscence: 95%
Normal healing: 5%

Second OR visit
7 days after injury

WoundDx model input variables:
1. Number of blood products received in the first 24h: 35
2. Number of blood products received at WRNMMC: 17
3. Serum Eotaxin: 57.5 pg/ml
4. Serum IL-1α: 16.2 pg/ml
5. Wound exudate IL-4: 6.13 pg/ml
6. Wound exudate IL-6: 107,000 pg/ml
7. Serum IL-7: 42.2 pg/ml
8. Serum MCP-1: 733 pg/ml
9. Use of Seroquel: No
10. Serum TNF-α: 0.748 pg/ml
11. Genitourinary trauma: No

Prediction of outcome:
Dehiscence: 91%
Normal healing: 9%

Third OR visit
9 days after injury

WoundDx model input variables:
1. Number of blood products received in the first 24h: 35
2. Number of blood products received at WRNMMC: 17
3. Serum Eotaxin: 72.7 pg/ml
4. Serum IL-1α: 38.1 pg/ml
5. Wound exudate IL-4: 6.13 pg/ml
6. Wound exudate IL-6: 5,350,000 pg/ml
7. Serum IL-7: 37.7 pg/ml
8. Serum MCP-1: 534 pg/ml
9. Use of Seroquel: No
10. Serum TNF-α: 1.08 pg/ml
11. Genitourinary trauma: No

Prediction of outcome:
Dehiscence: 95%
Normal healing: 5%

Fourth OR visit
11 days after injury

WoundDx model input variables:
1. Number of blood products received in the first 24h: 35
2. Number of blood products received at WRNMMC: 17
3. Serum Eotaxin: 55.8 pg/ml
4. Serum IL-1α: 18.1 pg/ml
5. Wound exudate IL-4: 10.8 pg/ml
6. Wound exudate IL-6: 5,350,000 pg/ml
7. Serum IL-7: 62.9 pg/ml
8. Serum MCP-1: 493 pg/ml
9. Use of Seroquel: No
10. Serum TNF-α: 1.22 pg/ml
11. Genitourinary trauma: No

Prediction of outcome:
Dehiscence: 81%
Normal healing: 19%

Wound was closed after 11 days of injury and dehisced

Translational Science Drives SC2i

SC2i Team