UNIT CELL PROCESSES ASSOCIATED WITH WOUND HEALING

I.V. Yannas, Ph.D. and M. Spector, Ph.D.
WOUND HEALING
Roots of the Tissue Response

Resolution → Slight Injury → Inflammation
(Vascularized tissue)

Healing Process

Regeneration*
CT: bone
Ep: epidermis
Muscle: smooth
*spontaneous

Repair (Scar)
CT: cartilage
Nerve
Muscle: cardiac, skel.

4 Tissue Categories
Connective Tissue
Epithelium
Nerve
Muscle

Nonvascularized tissue
No Healing
RESPONSE TO IMPLANTS: WOUND HEALING

Injury

Vascular Response

Inflammation

Tissue of Labile and Stable Cells

- Framework Intact
- Regeneration

Tissue of Permanent Cells

- Framework Destroyed
- Scar

Scarf
RESPONSE TO IMPLANTS:
WOUND HEALING

Surgical Implantation → Inc. time

Acute Inflammation

Vascular Response
- Clotting
- Phagocytosis
- Neovascularization
- New Collagen Synthesis

Granulation Tissue

Tissue of Labile and Stable Cells
- Framework Intact
  - Regen. (incorp. of implant)
- Framework Destroyed
  - Scarring
    - Chronic Inflammation

Tissue of Permanent Cells
- Implant Movement
- Scarring (fibrous encapsulation; synovium)
- Chronic Inflammation
UNIT CELL PROCESSES

Regulator

Cell + Matrix → Product + Regulator

Connective Tissue
Epithelia
Muscle
Nerve

ECM
Adhesion Protein
Collagen Biomaterial
Integrin

Mitosis
Synthesis
Migration
Contraction
Endocytosis
Exocytosis

UCP
UNIT CELL PROCESSES
VASCULAR RESPONSE

\[ \text{Contraction} \]
\[ \text{Endothelial Cell} + \text{Basal Lamina} \rightarrow \text{Leakage} + \text{Reg.} \]
UNIT CELL PROCESSES

VASCULAR RESPONSE

Platelet + serum $\rightarrow$ Reg.

Basophil + serum $\rightarrow$ Reg.

Mast Cell + ECM $\rightarrow$ Reg.

Endothelial Cell + Basal Lamina $\rightarrow$ Leakage + Reg.

Exocytosis

Serotonin

PAF

Histamine

Contraction
UNIT CELL PROCESSES
CLOTTING

Exocytosis
Platelet + Collagen → Coagulation factors
   ▼
   Fibrin polymerization
UNIT CELL PROCESSES
CLOTTING

Exocytosis
Platelet + Collagen → Coagulation factors

Exocytosis
Basophil + serum → Reg.

Exocytosis
Mast Cell + ECM → Reg.

Fibrin polymerization

PAF (In Circulation)

PAF (In Tissue)
Endocytosis


* Cell debris and degraded ECM
UNIT CELL PROCESSES
PHAGOCYTOSIS

Endocytosis


Fibroblast + ECM → + Reg.

Endothelial Cell + ECM → + Reg.

* Cell debris and degraded ECM
UNIT CELL PROCESSES
NEOVASCULARIZATION

Synthesis: enzymes

Endothelial Cell + Basal Lamina + Reg.

Migration

Endothelial Cell + ECM + Reg.

Mitosis

Endothelial Cell + ECM + Reg.
UNIT CELL PROCESSES
NEW COLLAGEN SYNTHESIS

**Fibroblast** + ECM → + Reg.

**Mitosis**
**Fibroblast** + ECM → + Reg.

**Synthesis**
**Fibroblast** + ECM → + Reg.

**Contraction**
**Fibroblast*** + ECM → + Reg.

*Myofibroblast
UNIT CELL PROCESSES
NEW COLLAGEN SYNTHESIS

Migration

Fibroblast + ECM → + Reg.

Mitosis

Fibroblast + ECM → + Reg.

Synthesis

Fibroblast + ECM → + Reg.
UNIT CELL PROCESSES

TGF-β1

↓

Contraction

Fibroblast + Collagen → Contracture + Reg.