Smoking and Wound Healing

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Smoking has long been targeted as a risk factor for many diseases and seen as detrimental to our health.

The aim of this presentation is to briefly outline the effect smoking has on wound healing in the skin at the cellular level.
Skin

- Complex structure made up of:
  - Epidermis
    - Thick keratinised stratified squamous epithelium
    - Cells present; keratinocytes, melanocytes, Langerhans’ cells and Merkel cells
  - Dermis
    - Strong, flexible connective tissue layer
    - Cells present; fibroblasts, macrophages, occasional mast cell and white blood cell
    - Richly supplied with nerve fibres, blood and lymphatic vessels
Wound Healing

- Very complicated process
- Although continuous, has been separated into phases
  - Coagulation
  - Inflammation
  - Proliferation
  - Remodelling
- Delay or absence of any one component can lead to prolongation or inhibition of healing
Factors Affecting Healing

- Local
  - Growth factors, oedema, ischaemia, low oxygen tension and infection

- Regional
  - Arterial and venous insufficiency and neuropathy

- Systemic
  - Inadequate perfusion and metabolic disease

- Miscellaneous
  - Nutritional status, pre-existing illness, radiation treatment and smoking
Cigarette Smoke

- Nicotine is the only pharmacologically active substance in tobacco smoke, apart from carcinogenic tars, HCN, and CO.
- Nicotine rapidly absorbed and can easily cross membrane barriers.
- Elimination half life of about 2 hours
Nicotine

- Initially causes nausea and vomiting
- Central nervous system effects
  - Balance neuronal excitation and desensitisation
  - Spinal level; skeletal muscle relaxation
- Peripheral effects
  - Mainly of heart and lungs; tachycardia, increased cardiac contractility and increased arterial BP
  - Reduced gastric motility
- Fluid retention
Smoking and the Skin

- Smoke itself has a drying effect
- Nicotine causes vasoconstriction
- CO damages prostacyclin production in the lining of the vessels
- Affects wound healing via tissue perfusion and oxygenation, cell function and replication, epithelialisation and collagen production
Tissue perfusion & oxygenation

- Smoking found to decrease tissue oxygen
  - Cell replication, collagen deposition and angiogenesis are all oxygen-dependent
- Hypoxia correlated with levels of Nicotine
- Carboxyhaemoglobin
- Individuals that smoke 1 pack per day will be hypoxic for majority of the day
Cell function & replication

- Enhanced platelet aggregation.
- HCN inhibits enzyme systems responsible for oxidative metabolism & oxygen transport.
- Reduced oxidative burst of inflammatory cells.
- Decreased keratinocyte, leukocyte and fibroblast migration. Also increased fibroblast survival.
Collagen synthesis

- Decreased synthesis rate of type I and III collagens in skin
- Lower median amount of collagen in smokers, therefore wound sites will be weaker and less resilient

Connective tissue cell
Conclusion

- Lack of studies assessing
  - the difference in healing time frame of smokers versus non-smokers
  - the actual quality of the repaired skin
- While some effects of Nicotine are rapidly reversed some may continue, these need assessment
  - Eg the effects of pre-operative cessation of smoking on wound healing outcome
Study limitations

- Some studies involved animals
- In vitro versus in vivo
- Small number of participants
  - Less data; higher incidence error and idiosyncratic results influencing outcome
- Need for clear cut definition of what actually determines a chronic smoker
  - At what level of smoking do these effects become relevant?