Blood Glucose Control and Diabetic Foot Ulcers

Anne Fourney, RN, BNSc, CDE

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It is estimated that 1 out of 4 (app 26%) hospitalized patients has diabetes mellitus (DM)

- The majority of hospitalizations for patients with diabetes are not directly related to their metabolic state and diabetes management is rarely the primary focus of care
- Glycemic control and other diabetes care issues are therefore often not adequately addressed

*Rohan SH, Chassin MR, Diabetes Care. 2001; 24-: 1371-1376

- Evidence based research supports targeted glycemic control in the hospital setting, with a potential for improved mortality, morbity and healthcare economic outcomes

* Campbell KB, Clin Diabetes 2004; 22: 81-88

- Approximately 15% of people with diabetes will develop a foot ulcer
- 85% of lower extremity amputations are preceded by foot ulcers, of these 14-24% will proceed to major amputations
- Up to 34% of patients develop another ulcer within one year of healing while the 5 year rate of re-ulcerations has been shown to be 70%

- There can be a reduction of non-traumatic amputations after implementing a multidisciplinary approach to foot care and management of foot ulcers
- The multidisciplinary approach would address:
  - Glycemic control
  - Infection
  - Lower extremity vascular status
  - Local wound care

Patients with DM have

- Impaired wound healing when compared to the general population
- Increased incidence of infection
- Increased length of stay in the hospital

- The increased risk for infection is partly due to elevated glucose levels in body fluids which provides an ideal medium for bacterial growth
- When patients with diabetes undergo surgery they tend to have muted immune response to infections
- As a result, less bacterial counts are needed to progress in to a wound infections

Hyperglycemia and Infection

- Cardiac Surgery Population:
  - Higher peri-operative glucose levels were associated with increasing rates of infection

- General Surgical Population:
  - Patients with blood glucose > 12.2 on first post-operative day
    - 2.7 times higher infection rate
    - 5.7 times serious infection rate

Pomposelli et al, J Parent Nutr 22; 77-81, 2000

Golden S et al, Diabetes Care 22: 1408-1414

Recommended blood glucose targets for people with diabetes

- Fasting or premeal blood glucose: 4.0-7.0 (normal range is 4.0-6.0mmol/L)
- 2 hours after eating: 5.0 – 10.0 (normal range is 5.0 – 8.0mmol/L)

Other factors affecting wound healing

- Impaired migration of neutrophils to the surgical site due to vascular changes associated with advanced atherosclerosis
- The erythrocytes stiffen and lose the ability to penetrate small capillaries resulting in inadequate oxygen tension and impaired oxidative destruction of pathogens
- The endothelium thickens, impairing blood flow through the capillaries

Canadian Diabetes Association 2008 Guidelines for In-hospital Management of Diabetes

- Provided that their medical conditions, dietary intake and glycemic control are acceptable, patients with diabetes should be maintained on their prehospitalization oral antihyperglycemic agents or insulin regime

- For hospitalized patients managed on insulin, a proactive approach, that includes a basal, mealtime and correction-dose insulin along with pattern management is preferred over the "sliding scale" approach

Target Blood Glucose Levels

- Target 4.5- 6 mmol/L in ICU
- **Target 5-11 mmol/L in surgery patients**
- Target 5.5-10 mmol/L intraoperative for CABG

The latest article

- "Tight Glucose Control Increases Mortality in Critically Ill Patients" N Engl J Med 2009; 360: 1283-97
- Trial compared tight control (4.5- 6 mmol/L v 8-10 mmol/L)
- More patients in the intensively treated group died within 90 days (27.5% v 24.9%)
- Still important though to aim for BG control from 8-10mmol/L

Hypoglycemia (BG less than 4mmol/L)

- Hypoglycemia remains a major impediment to achieve optimal glycemic control in hospitalized patients

- Benefits of improved perioperative glycemic control must be weighed against the risk of perioperative hypoglycemia
- Anesthetic agents and postoperative analgesia may alter the patient's level of consciousness and awareness of hypolgycemia
- Risk of hypoglycemia can be reduced by frequent BG monitoring and carefully designed management protocols.

Recommendations

- In hospitalized patients, efforts must be made to ensure that patients using insulin or insulin secretagogues have ready access to an appropriate form of glucose at all times, particularly when NPO or during diagnostic procedures

Summary

- Diabetes is common in hospital and frequently glycemic control is not adequately addressed
- Diabetes is associated with longer lengths of stay
- Hyperglycemia is associated with negative clinical outcomes especially increased risk of infection, poor wound healing and increased risk of amputation
- Blood glucose should be maintained between 5 - 11mmol/L and hypoglycemia should be avoided

Advanced Wound Care Options for Recalcitrant Wounds of the Lower Limb

Chris Murphy RN ET BSc (hons)

Hyperbaric therapy (Oxygenation)

NPWT (Perfusion)

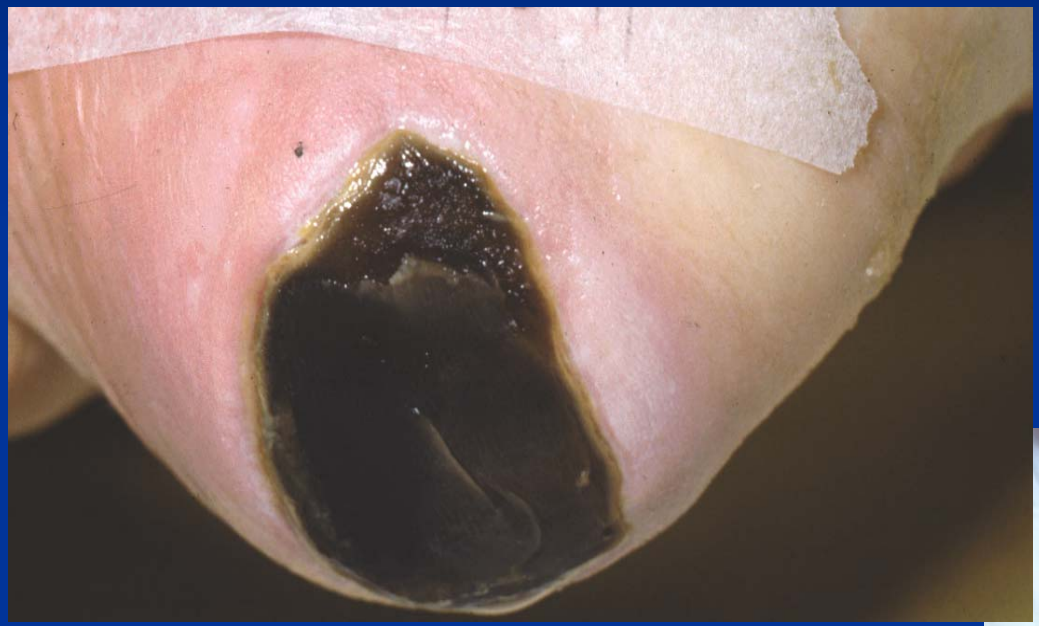
IPC (Perfusion)

Dynamic closure device (approximation)

UVC Light Tx (bioburden)

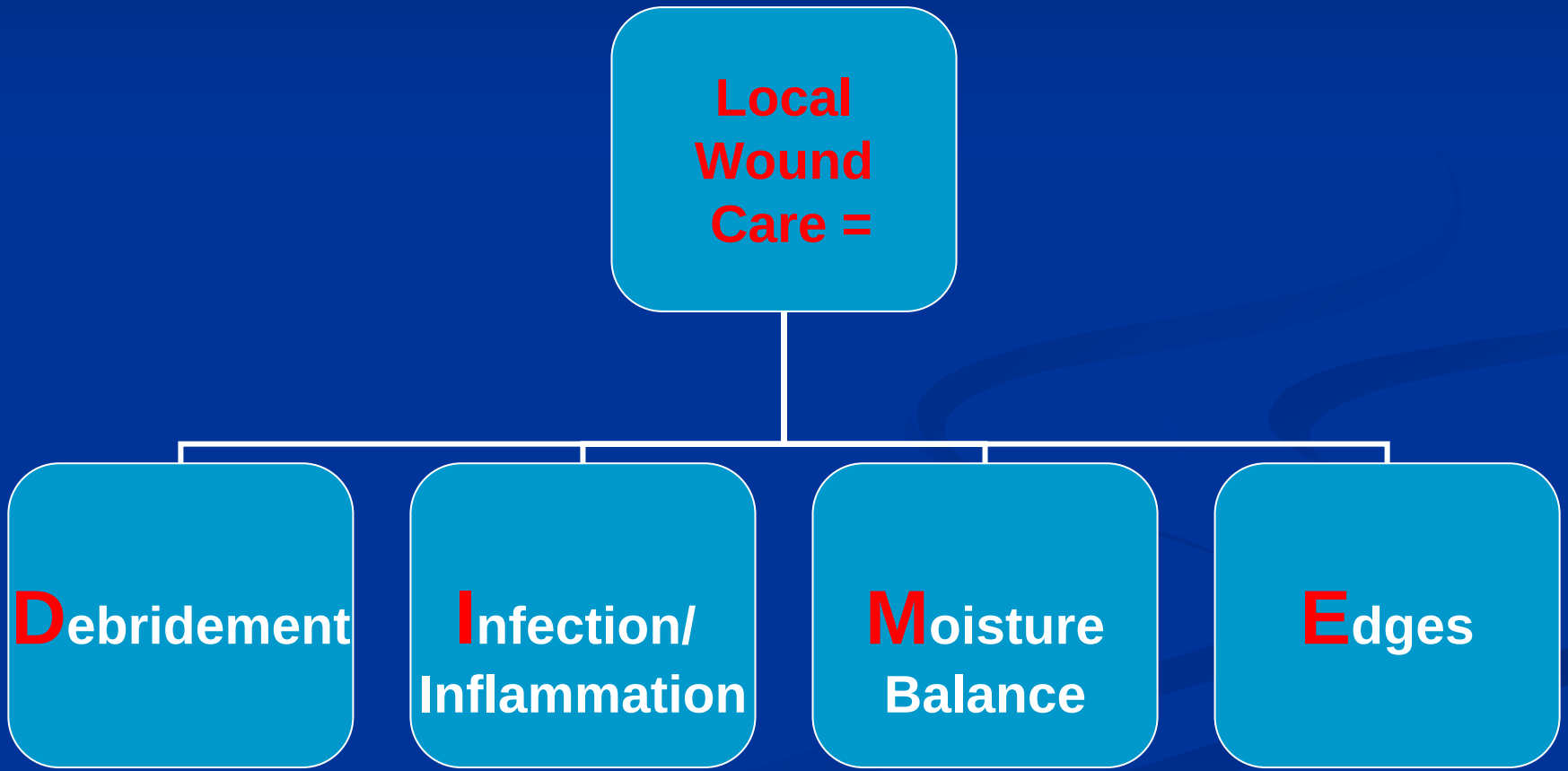
Biologicals (growth factors scaffold)

Heel Ulcer in Vascular Sx Client



D.I.M.E.
Local wound bed prep

1. Treat the cause
2. Patient concerns



Adapted from CAWC Best Practice recommendations: Sibbald et al, 2006

1.Treat the cause.

- Primary cause ?: perfusion - angioplasty
  - bypass procedure
    - IPC
    - NPWT (e.g. VAC)

trauma - remove from scene

surgery - one time event

pressure - remove pressure

disease - optimize condition

Drugs,Edema,Anemia,low Albumin,Disease.

chemical/ thermal - remove causative factor

Intermittent Pneumatic Compression (IPC)

- Apply for an hour 2x/day x 6 months
- Feet dependant position.
- Improves perfusion.
- Easy to apply.
- Client rents machine – may be covered by insurance.
- Option for non-surgical candidates, or sub-optimal post reperfusion procedures.

Vacuum. Assisted. Closure. (Negative Pressure Wound Therapy)

Vacuum assisted closure dressing system applies constant negative pressure to the wound which:

- Removes exudate and reduces periwound oedema.
- Increases local microvascular blood flow.
- Promotes formation of granulation tissue.
- Reduces complexity/ size of the wound.
- Optimizes the wound bed prior to and following surgery.
- Reduces complexity of surgical wound closure procedures.

European Wound Management Association (EWMA), 2008

Trauma:


20/10/2008


10/10/2008

Foam types:

- Granufoam (black) – to enhance granulation production.

- Granufoam Ag (silver) – additional antimicrobial and deodorant effect.

  - Infected wounds or high risk wounds (e.g. orthopedic)

- Versafoam (white) – a ral with interface dressing not required.

  -Tunneling, near vascular graft sites, painful wounds.

Signs of deep wound infection:

- Size increase.
- Temperature increase.
- Os (probes to bone).
- New areas of breakdown – check satellite areas and for undermining.
- Exudate – purulence sometimes hemorrhagic component.
- Erythema < 2cm periwound.
- Edema, induration.
- Smell- foul odour.
- Increased Pain.

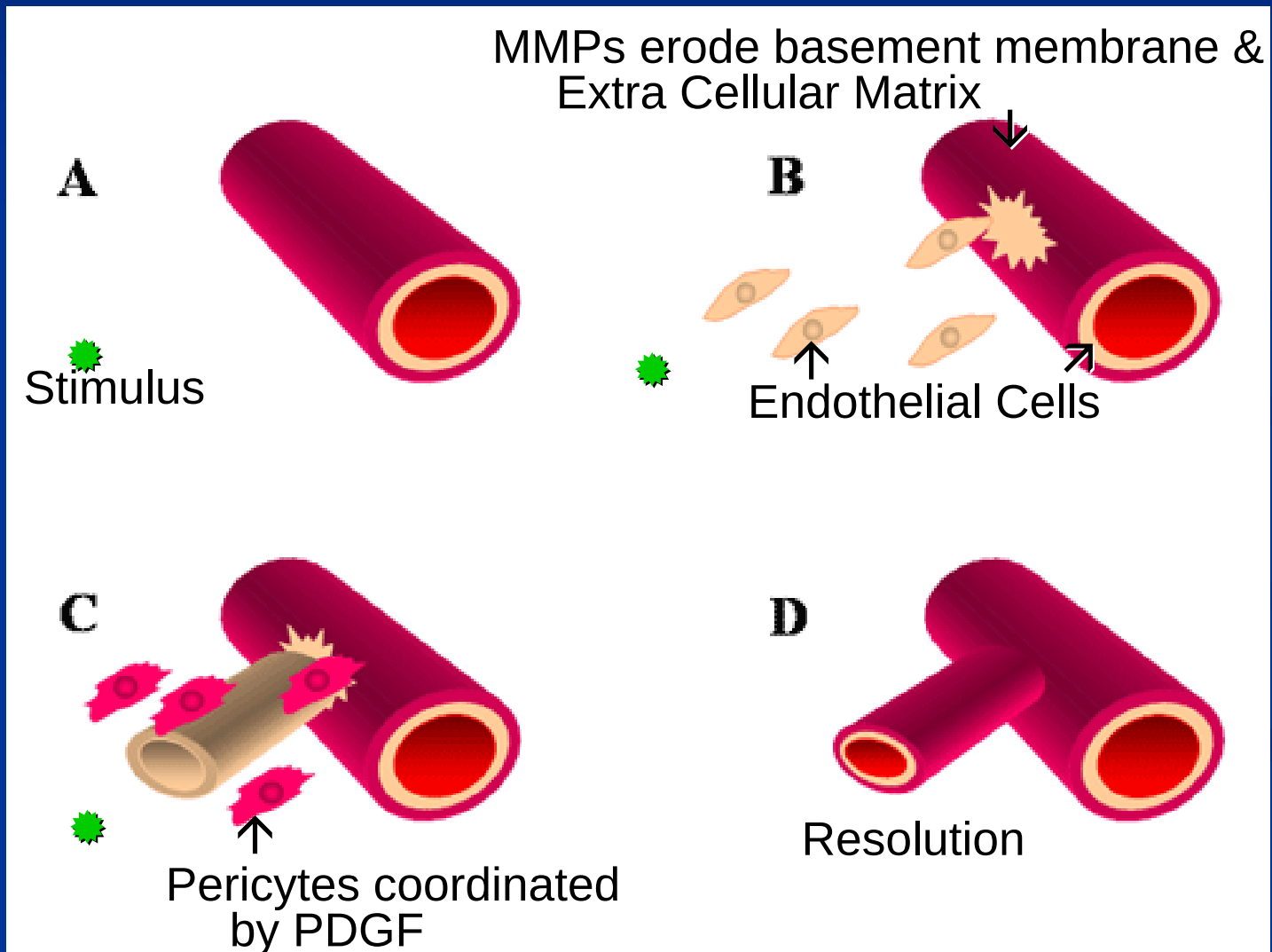
Treatment for High Bioburden.

- Local antimicrobials: ionic silver dressings, cadexomer iodine. Honey dressings evidence still pending.
- Antiseptics only if local bioburden is of greater concern than the stimulation of healing. Antiseptics are cytotoxic to granulating tissue.
- Systemic antibiotics added as necessary to prevent systemic infection.
- UVC light evidence pending.

Ionic Silver: Antimicrobial.

- Kills bacteria including MRSA and VRE.
- Silver resistance is rare.
- Ionic silver is highly toxic to microorganisms but has very low human tissue cell toxicity.
- Silver dressings have anti inflammatory properties.
- Much debate on how much silver is enough or too much.

Angiogenesis



MMP Modulating Dressings

Promote granulation by some of the following (brand dependant):

- chemotaxis of growth factors and MMPs.
- Protecting and releasing growth factors.
- Binding and inactivating MMPs (particularly MMP-2 and MMP-9) (Cullen et al. 2002)
- Absorption of free radicals.
- Haemostasis of bleeding wounds.
- Creation of a moist wound healing enviro

(Barrick et al., 1999)

Silver MMP Modulating Dressing with VAC

- Encourages granulation of chronic wound with antimicrobial benefits.
- Effective last ditch effort for limb salvage.

Hyperbaric Oxygen Therapy (HBOT)


31/10/2007


20/01/2006

Becaplermin gel (Regranex)

- Indicated for diabetic foot ulcers slow to heal (address VIP first).
- PDGF-BB (platelet derived-growth factor)
- Check insurance for coverage.
- Available with section 8 form but lengthy turnaround time.
- Apply dime thickness layer of gel daily, then outer dressing.
- Must be refrigerated.

Biologicals

- Collagen (scaffold and strength)
- Growth factors

Still no progression?

- Reassess heal ability and goal of care.
- Consider biopsy

r/o underlying pathology:

-calciphylaxis (especially if ESRD)

-vasculitis

-malignancy, Marjolin's ulcer.

- r/o osteomyelitis.

Online resources:

cawc.net

(Canadian Association of Wound Care – Practice Recommendations)

ewma.org

(European Wound Management Association – Consensus Documents)

rnao.org

(Registered Nurses of Ontario - Best Practice Guidelines

worldwidewounds.com

Thank you!!

- Questions?…….