DIABETIC FOOT ULCER

FACT OR CONVENIENT DIAGNOSIS

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Epidemiology and physiology

Limb wounds in persons living with Diabetes

Patient assessments

Case studies and discussion
Sometimes there`s more gray than black and white
What Is Diabetes?

Type 1 diabetes (5-10%)
• Body’s own immune system attacks the cells in the pancreas that produce insulin

Type 2 diabetes (90 - 95%)
The pancreas does not produce enough insulin and/or the bodies’ tissues do not respond properly to the actions of insulin
• Caused by both genetic and environmental factors

Gestational diabetes
• Diabetes with first onset or recognition during pregnancy
• Puts women at higher risk for type 2 DM later in life
What Diabetes is NOT

• Diabetes is NOT “a touch of sugar”

• It is a serious chronic disease that can lead to complications such as heart attack, stroke, blindness, amputation, kidney disease, sexual dysfunction, and nerve damage
Diabetes Complications

Macrovascular
- Stroke
- Heart disease and hypertension
- Peripheral vascular disease
- Ulcers and amputation

Microvascular
- Diabetic eye disease (retinopathy and cataracts)
- Renal disease (Kidney)
- Neuropathy
- Foot problems
Diabetes = CVD

Up to 80% of adults with diabetes will die of cardiovascular disease

Adapted from Barrett-Connor 2001.
Cardiovascular Disease

• Diabetes is a major risk factor for heart disease and stroke
• Acute MI (heart attack) occurs 15 to 20 years earlier in people with diabetes
• 80% of people with diabetes will die from cardiovascular disease
Amputation

- Diabetes is the leading cause of non-traumatic amputation
- Increases the risk of amputation by 20 fold
- 70% of all leg amputations happen to people living with diabetes.
  (Globally, > 1 million / year, 1 every 30 seconds).
- Foot ulcers precede the majority of amputations
- In developed countries 1 in 6 diabetics will have an ulcer
What is an Ulcer?

• An ulcer is a discontinuity or break in a bodily membrane that impedes the organ of which that membrane is a part from continuing its normal functions. Common forms of ulcers recognized in medicine include:
  – Pressure ulcers, ulcerative dermatitis, ulcerative lichen planus, venous ulcers.
Ulcer classifications

- Pressure / Decubitus ulcers
  - European pressure ulcer advisory panel
  - Texas wound classification
  - Wagner
- Neurovascular ulcers – CEAP (6 stages)
- Burns – (stages and severity)
- Infections
Diagnose the Etiology

- Neurovascular,
- Biomechanical,
- Trauma
- Systemic conditions
- Microbes

PATIENT HISTORY
Diabetic foot ulcers

• An open sore on the foot that occurs in people with diabetes who have damage to nerves and/or have poor blood flow to the feet..

• www.johnshopkinshealthalerts.com/reports/diabetes/923-1.html
Wounds types seen in the diabetic foot

- Traumatic
- Pressure
- Venous
- Ischaemic
- Neurovascular
- Epithelioma
- Pyoderma gangrenosum
- Vasculitic
- Lymphatic
- Rheumatic
- Gout
- Exostosis
- Bites
- Verucoid
Ulcer audit in Saskatchewan Podiatry clinic

The objective of this research project was to determine the:

• **success of wound healing** and
• **amputation prevention.**
• extrapolate data on the number and type of ulcers treated, recurrence of ulcers and healing status.
Methodology

• Ulcer patients who presented to the RQHR Podiatry Clinic between January 1, 2010 and December 31, 2010 were identified.

• An Ulcer was defined using the University of Texas Wound classification system that had a grading of at least 1. “Superficial wound not involving tendon, capsule or bone (University of Texas Health Science Center, n.d.).

• Due to some variations in charting and patients having their service transferred to rural locations, some wound and ulcer patients may have been missed during the data entry.

• The data was entered into a standard database and was analyzed using Microsoft Excel
### Proportion of Diabetic and Non-Diabetic Patients Treated for an Ulcer by Age Group and Gender, RQHR,
January 1, 2010 to December 31, 2010

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Male Diabetic</th>
<th>Female Diabetic</th>
<th>Male Non-Diabetic</th>
<th>Female Non-Diabetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>20-44</td>
<td>5.1%</td>
<td>0.9%</td>
<td>1.7%</td>
<td>0.9%</td>
</tr>
<tr>
<td>45-64</td>
<td>18.8%</td>
<td>11.1%</td>
<td>2.6%</td>
<td>3.4%</td>
</tr>
<tr>
<td>65+</td>
<td>29.1%</td>
<td>6.8%</td>
<td>5.1%</td>
<td>14.5%</td>
</tr>
</tbody>
</table>
Demographic data

• A total of 206 ulcers, (71.8%) diabetic and (28.2%) non-diabetic charts were identified for data abstraction.

• On average, diabetic patients were younger than non-diabetic patients (mean average age = 63.6 diabetic and 71.4 non-diabetic).

• The ratio of male to female diabetic patients was 2.82:1.

• For non-diabetic patients, the male to female ratio was 0.5:1.

• The highest proportion of ulcer patients was 29.1% for male diabetic patients aged 65 and older.
Diabetic patients made up the greatest proportion of ulcer treatments in 2010 at 71.8% of the visits. The proportion of non-diabetic patients seen for ulcers was 28.2%.
• Type 2 diabetic patients made up the majority of the ulcer patients treated in 2010 at 65.8% and

• non-diabetic patients made up the second highest group at 28.2% of ulcer treatments.

• Type 1 (4.3%) and unknown diabetic type (1.7%) made up a very small proportion of patients treated for an ulcer.
Proportion of Patients Who Received Treatment for an Ulcer, by Diabetic Status, RQHR, January 1, 2010 to December 31, 2010

- Type 1 Diabetic Patients: 4.3%
- Type 2 Diabetic Patients: 65.8%
- Unknown Diabetic Type: 1.7%
- Non-Diabetic Patients: 28.2%
OUTCOMES

- **Healing** of ulcers occurred in **67.5%** of diabetic and non-diabetic patients seen in 2010. The patients that didn’t have healing by December 31, 2010 have continued to be seen in 2011 and some patients have had healing during that time.

- Unfortunately **14.6%** of ulcer patients **did not return** to the RQHR Podiatry Clinic for follow-up on their ulcer therefore; healing was unknown.

- A very small proportion (3.4%) of diabetic and non-diabetic patients required amputations for ulcers that were not able to be healed.
Proportion of Diabetic and Non-Diabetic Patients Treated for Ulcers by Healing Status, RQHR, January 1, 2010 to December 31, 2010

Healing Status as of December 31, 2010

- Healed: 67.5%
- Not Healed: 14.6%
- Healing Unknown: 14.6%
- Amputation: 3.4%
• Diabetic patients seen had a higher proportion of healed (70.6%) ulcers than non-diabetic patients (55.8%) seen by the RQHR Podiatry Clinic in 2010.

• Ulcers that hadn’t healed by the end of 2010 were also higher for non-diabetic patients.
• The proportion of patients that required amputations was slightly higher for diabetic patients (3.7%) than non-diabetic patients (2.3%).
Proportion of Ulcers Treated by Diabetic Status, RQHR, January 1, 2010 to December 31, 2010

Wound Status as of December 31, 2010

Healed
Diabetic: 70.6%
Non Diabetic: 55.8%

No Healing
Diabetic: 12.3%
Non Diabetic: 23.3%

Healing Unknown
Diabetic: 13.5%
Non Diabetic: 18.6%

Amputation
Diabetic: 3.7%
Non Diabetic: 2.3%
Diabetic patients were seen for a higher number of recurrent ulcers.
All Ulcers Treated for Diabetic and Non-Diabetic Patients, RQHR, January 1, 2010 to December 31, 2010

<table>
<thead>
<tr>
<th>Type of Ulcers</th>
<th>Number of Ulcers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyoderma Gangrenosum</td>
<td>2</td>
</tr>
<tr>
<td>Arterial</td>
<td>3</td>
</tr>
<tr>
<td>Neoplasm</td>
<td>3</td>
</tr>
<tr>
<td>Surgical</td>
<td>4</td>
</tr>
<tr>
<td>Rheumatoid</td>
<td>5</td>
</tr>
<tr>
<td>Traumatic</td>
<td>9</td>
</tr>
<tr>
<td>Venous</td>
<td>15</td>
</tr>
<tr>
<td>Ischemic</td>
<td>22</td>
</tr>
<tr>
<td>Pressure</td>
<td>22</td>
</tr>
<tr>
<td>Neuropathic</td>
<td>121</td>
</tr>
</tbody>
</table>
Top Three Ulcer Types for Diabetic and Non-Diabetic Patients

**DIABETIC**
- Neuropathic Ulcers (75.6)
- Pressure Ulcers (12.8)
- Ischemic Ulcers (6.7)

**NON_Diabetic**
- Venous Ulcers (22.8)
- Pressure Ulcers (21.1)
- Traumatic Ulcers (15.8)
Diabetic and Non-Diabetic Patients Treated for an Infected Ulcer, RQHR, January 1, 2010 to December 31, 2010

<table>
<thead>
<tr>
<th>Diabetic Status</th>
<th>Proportion of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic</td>
<td>29.1%</td>
</tr>
<tr>
<td>Non-Diabetic</td>
<td>8.5%</td>
</tr>
</tbody>
</table>

42.7% of patients had an infection, with 29.1% among diabetics and 8.5% among non-diabetics.
In 2010, 62.4% of ulcer patients had no infection and 37.6% presented or developed an infection. The majority of patients treated for an infection were diabetic patients (42.7%).
Conclusion of Audit

• The finding of this research project suggests that ulcer types differ from diabetic and non-diabetic patients.
• Three quarters of diabetic patients are treated for neuropathic ulcers. Since neuropathic foot ulcers remain the prime precipitant of diabetes related lower limb amputations [LEA] it is crucial that ulcer patients have access to podiatry serves.
• Retrospectively non-diabetic patients were more likely to be treated for venous, pressure or traumatic type ulcers.
• This projecte also determined that diabetic patients treated tended to be younger than the non-diabetic patients.
• Of the patients that required amputation only one was a below knee amputation [BKA] the others were minor amputations.
Conclusion

- Infection rates were relatively low at 37.6% of ulcer patients. The proportion of diabetic patients that were treated for infections was twice as high (29.1%) as non-diabetic patients (8.5%).

- Specialty diabetic foot clinics have been shown to reduce the incidence of ulceration and amputation in high-risk patients (Edmonds, Blundell, Thomas & Watkins, 1986). Often these foot clinics provide protective shoes and insoles, foot-specific education, and advanced clinical care. These clinics usually deliver services that are well above the local community standard. However, even in specialty foot clinics, recurrence of diabetic foot ulcers is often very high, generally ranging from 25 to 80% per annum (Busch & Chantelau, 2003).
Personal challenges with wounds

- Necrosis and slough
- Exudate
- Pressure relief
- Compliance – the team
- Preventing infection
- Tissue viability
- Maintain healed state
Infection

- All chronic wounds harbour bacteria. — contaminated, colonised, or infected.

Infection = dose x virulence
host resistance
Bio-film

• *Correction of the bacterial balance* may be inhibited by the presence of a **biofilm** (microorganisms within a secreted glycocalyx).

• Biofilm represents a *focus for infection*, which is protected from the effects of antimicrobials, including antibiotics.

• Not all organisms within a biofilm will be the same, which compounds the problems associated with treatment or eradication.
Management of necrosis

• The most obvious marker of a chronic wound is the presence of necrotic tissue, which can be both a focus for bacteria and a barrier to healing.

• A 'mixed' wound is usually created when some areas harbour significant necrotic material and bacteria while other areas produce exudate.

• These changes within a wound necessitate a flexible approach to debridement.
Consequences of not debriding a wound:

• Increased risk of infection
• Imposition of additional metabolic load
• Psychological stress
• Ongoing inflammation
• Compromised restoration of skin function
• Abscess formation
• Odour
• Inability to fully assess the wound depth
• Nutritional loss through exudate
• Sub-optimal clinical and cosmetic outcome
• Delayed healing

Defined by Baharestani [8]
Available methods for debridement

- **Surgical** - highly selective with rapid results
- **Sharp** - should only be undertaken by a skilled practitioner
- **Larval** - larvae of *Lucilia sericata* (greenbottle fly)
- **Enzymatic** - streptokinase or streptodornase or bacterial-derived collagenases
- **Autolytic** - hydrocolloids and hydrogels
- **Mechanical** - hydrotherapy and wound irrigation
- **Chemical** - hypochlorite

For many wounds, WBP will require the use of more than one debridement technique, either within the initial phase of debridement or for maintenance debridement.
The choice of an appropriate debridement method will depend on:

- Wound characteristics
  - infection
  - pain
  - exudate
  - involved tissues
  - required rate of debridement
- Patient's attitude
- Available skills
- Available resources
  - products
  - costs
Exudate management consists of two related phases of management:

- **Indirect**
  - Control of infection or bacterial load
  - Control of oedema by systemic therapy, such as treatment of heart or renal failure
  - Use of immunosuppression or steroids to control inflammatory exudate from wounds, such as pyoderma gangrenousum, vasculitic or rheumatoid ulcers.

- **Direct**
  - Use of absorbent dressings
  - Use of compression and/or elevation to eliminate fluid from the wound site
  - Use of Topical Negative Pressure (TNP) with devices such as Vacuum Assisted Closure – (VAC)
Wound healing in normal hosts follows an orderly biological process involving several cellular and molecular events that are traditionally organized into three main phases.

Towards healing

**Time from injury**

- **Haemostasis**
- **Platelets**
- **Fibrin**
- **Proteoglycans**
- **Inflammation**
- **Neutrophils**
- **Macrophages**
- **Lymphocytes**
- **Proliferation**
- **Fibroblasts**
- **Collagen**
- **Epithelial cells**
- **Endothelial cells**
- **Remodelling**
- **Scar Maturation**

**Collagen Fibril Crosslinking**
Dressing type selection by category

- Absorptive Dressing
- Alginates
- Antimicrobials
- Cleansers
- Closure Devices (new)
- Collagen
- Compression Dressing & Wraps (Leg)
- Composite Dressing
- Contact Layer
- Enzymatic Debriders
- Fillers (wound)
- Foam Dressings
- Growth Factors (see Tissue Engineering and Growth Factors)

- Hydrocolloid
- Hydrofiber
- Hydrogel
- Hydrogel Impregnated Gauze
- Hydrogel Sheet
- Measuring Devices
- Miscellaneous Devices
- Negative Pressure Wound Therapy (NPWT)
- Odor Absorbing
- Scar Therapy and Makeup
- Skin Care
- Skin Substitutes
- Therapeutic Shoe Gear
- Tissue Engineering / Growth Factors
- Transparent Films
Case studies

Informal dressing evaluation
Neuropathic ulcer with deformity

- 66 yr old male
- DM since 1995, last HbA1C 6.6%
- IHD, HPT, denies smoking and EtOH
- Right 3rd toe amp Jan/10 (4 months to heal)
- 1980 – right ankle ORIF
- Pulses faint, Doppler biphasic, brisk & hyperemic
- Peripheral neuropathy (0/10 10 g monofilament)
- Clawing of lesser toes with prominent metatarsals
- Compression stockings used routinely.
- Clindamycin 500mg & Ciprofloxacin 300mg
Case of the Jam Container

- 79 yr old male
- DM since 1968, insulin, avg BS 5.6 mmol/1
- Denies smoking and EtOH
- Peripheral neuropathy
- Feet well perfused. denies claudication & rest pain
- NKDA
- Developed a lesion on left 5th toe 10 days ago.
- Tx Plan – ABx dressing – refer for Amp and Abx
The Callus that got away: Infection

- 62 yr old male
- DM since 2003, last HbA1c 7.7%
- Hpt, hyperlipidemia, gout, IHD
- Left arm PICC line for Abx (currently on none)
- 30 sessions of HBOT finished 2/52 ago
- Denies claudication and rest pain, pulses bounding, digital hair and SCVFT 2 seconds
- Peripheral neuropathy – 0/10 10 g monofilament, Diminished plantar reflexes
- Left charco osteoarthropathy, callused, uses insole
- Tx Plan – wound assessment, total offloading
From fistula implant to hip fracture

- 47 yr old female
- DM since 1978 (Type 1 age 5), avg BG 5-8 mmol/L
- Dialysis since 2005
- Hyperlipidemia, IHD, restless legs, peripheral neuropathy, PAD
- Biphasic doppler with toe pressure of 65mmHg
- Right ankle fused & left drop foot AFO’s
- Left charcot foot 2008 – orthotics
- Hemodialysis arm fistula failed and inserted into right leg
- Developed right heel pressure ulcer July 2009
- Uses a scooter for mobility
- Bilateral hip replacement July 21
Callus debrided at walk-in clinic

- 49 yr old female
- DM since 1995, insulin since 2008, HbA1c 6%
- HPT, Hyperlipidemia, Psoriasis (photo therapy)
- No peripheral vascular compromise
- No loss of protective sensation, reflexes normal
- No hallux or lesser toe deformities
- Developed callus and not comfortable to treat on own.
- Walk-in clinic debrided site. Seen 1 week later for Abx.
New shoes from children for a dance

- 56 yr old female
- GDM and Dx DM 1992, avg BG 7-9 mmol/L
- HPT, Hyperlipidemia, PAD
- Onset of peripheral neuropathy 5/10 10g monofilaments appreciated
- Reflexes normal, pulsed bounding
- Stepped on glass initially – multiple courses of Abx.
- Wound at end stage healing when daughters bought shoes for her to go dancing for a night.
Wet total contact cast

- 65 year old male
- DM since 1985 on insulin. Ave 7-9 mmol/l
- Peripheral neuropathy > 10 years
- Pulses palpable, feet warm & well perfused
- Non smoker moderate EtOH
- HPT, Hyperlipidemia and IHD
- Ruptured right achilles tendon 2005
- Aherniated Plantar fat pad; TCC; Blister; Cold lazer;