Diabetes and How it Can Adversely Affect Recovery

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One Call

PRESENTED
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Agenda

- Define diabetes – types and symptoms
- Learn to recognize possible complications
- Understand long-term repercussions of uncontrolled diabetes
- Discuss treatment considerations, including Hyperbaric Oxygen Chamber Therapy (HBOT) for wound healing
- Discuss the importance of nutrition in diabetes-related cases, and its relationship to recovery and medical costs

Diabetes and Symptoms

Type 1 Diabetes: pancreas does not make enough insulin and completely shuts down; glucose levels rise

Type 2 Diabetes: body's inability to use the insulin that it produces effectively causing increased glucose levels

Excessive thirst	Frequent Urination	Weight Loss	Lethargic

Source: Retrieved from http://www.diabetes.org

Scope of the Challenge

In 2015 diabetes affected 30.3 million people of all ages

9.4% of the population

Approximately 1.25 M American children and adults have Type 1

Diagnosed	Undiagnosed
23.1 M	**7.2 M**

Source: Retrieved from http://www.diabetes.org/diabetes-basics/statistics-revised-3/22/18

Poorly controlled diabetes can result in:

- Delayed Healing
- Infections
- Increased recovery time
- Increased reserves and long length of disability

American Diabetes Association standards:

- **Blood Sugar Range:** 80-130 mg/dl before meal
- **Blood Sugar Range:** Less than 180mg/dl post meal
- **A1C**: Less than 7%-Test the average level of blood sugar over past 2-3 months

Source: Retrieved from http://www.diabetes.org/diabetes-basics/statistics-revised-3/22/18

Controlling Diabetes

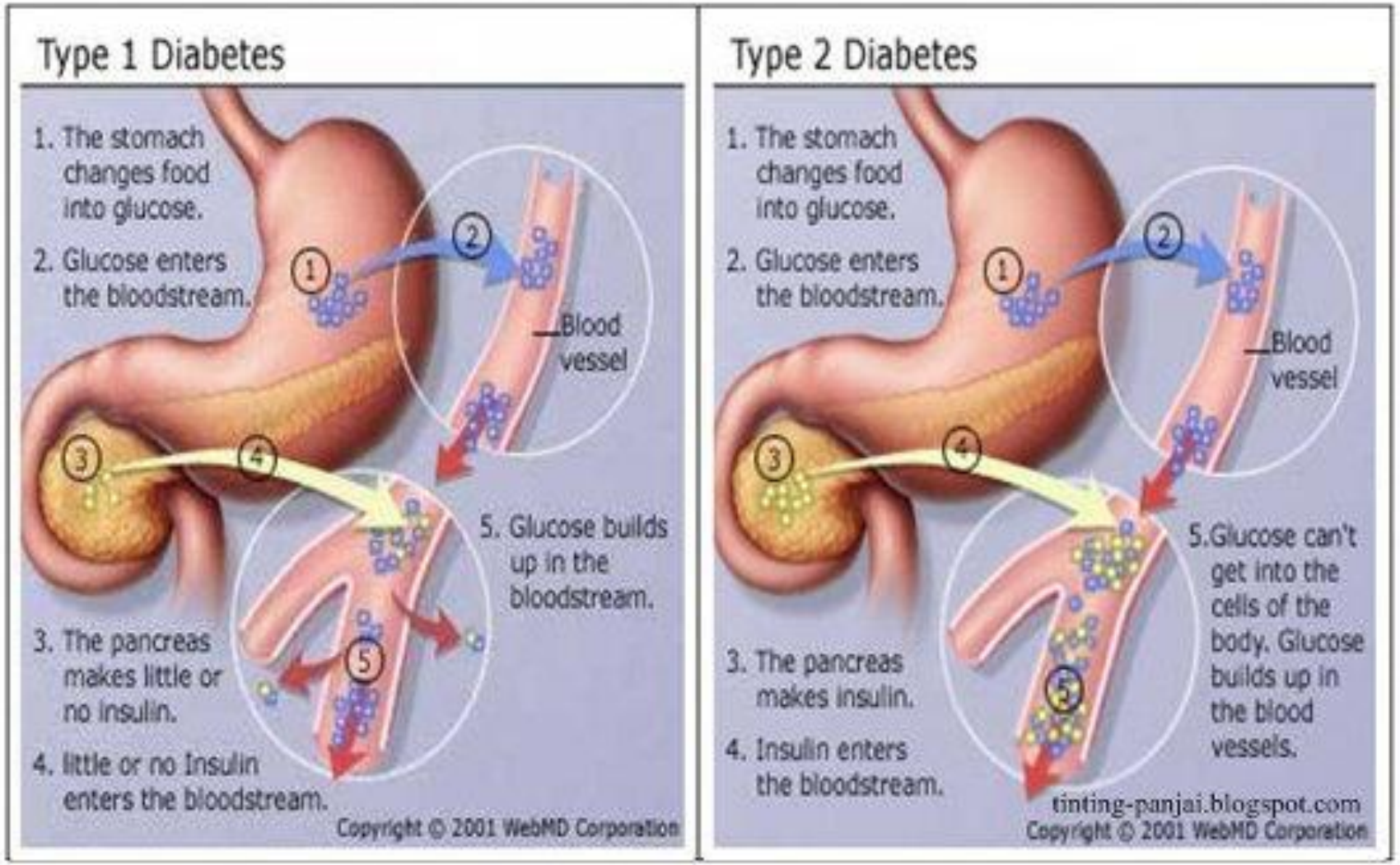
Exercise	Diet	Medication	Blood Testing

How Diabetes is Controlled

- **Type I:**
  - Insulin – from few injections to multiple injections
  - Pump
  - Diet
  - Exercise
  - Monitoring

- **Type II:**
  - Oral medications
  - Diet
  - Exercise
  - Monitoring
  - Sometimes both insulin and oral medications

Insulin Production



Source: Retrieved from http://www.howtolivealongerlife.com/2009/11/insulin-production-and-fiber.html

Complications

Diabetic Ketoacidosis:

Ketoacidosis (key-toe-ass-i-DOE-sis); can lead to diabetic coma or even death

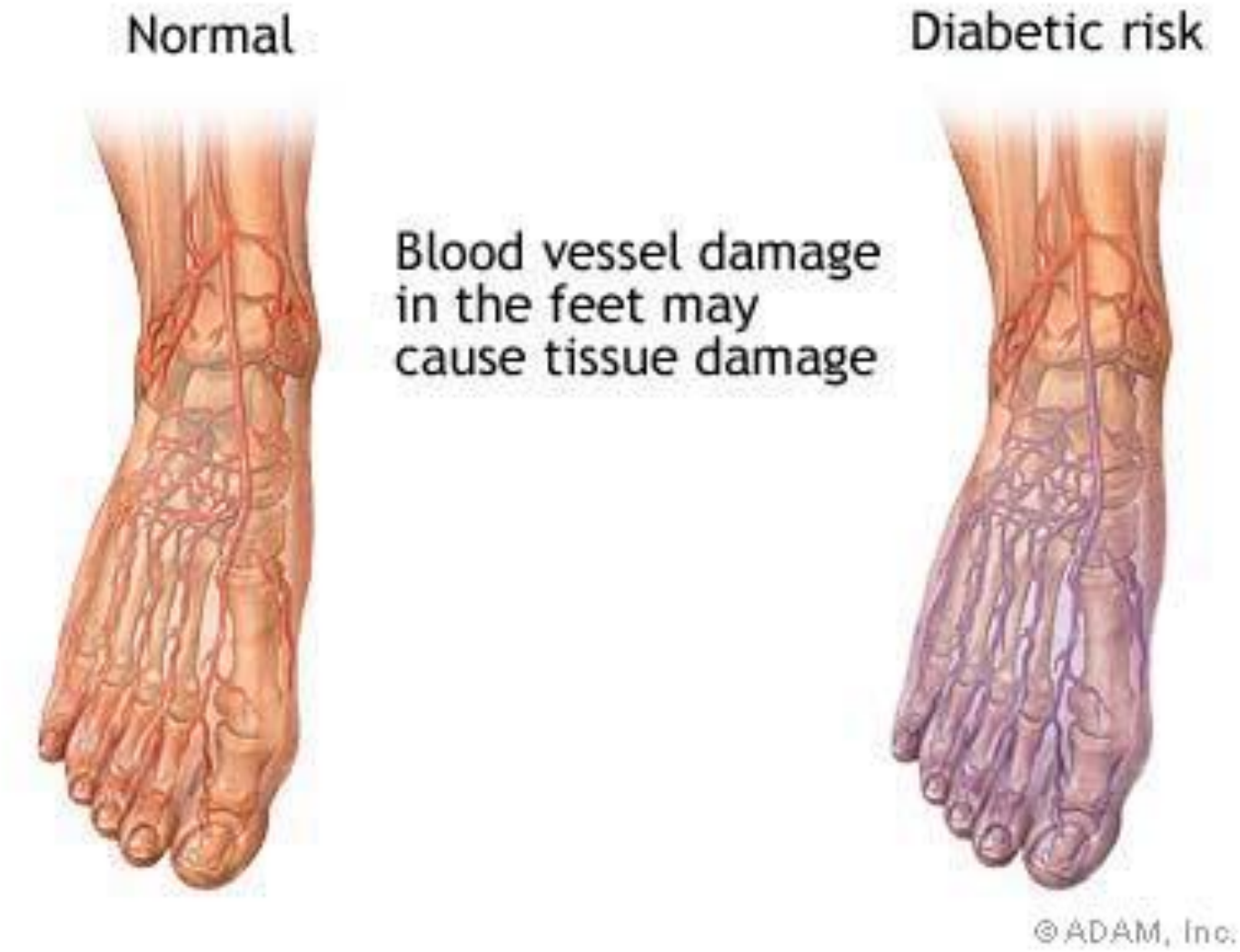
Hypoglycemia:

Low blood Sugar 70mg/dl

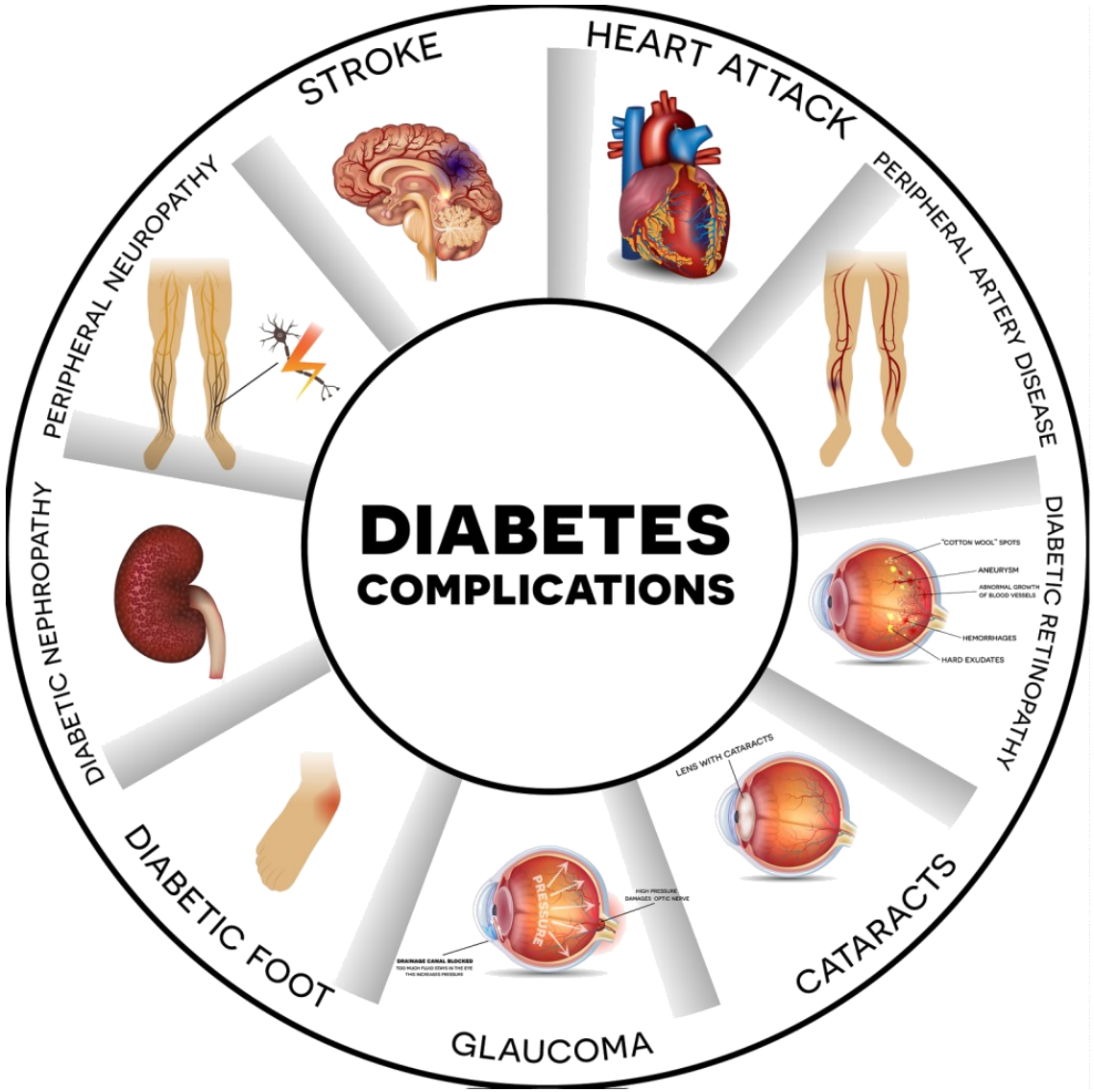
Hyperglycemia:

High Blood Sugar 240mg/dl.

Diabetes and Circulation



Possible Long Term Complications



Source: Retrieved from https://knoxvillehospital.org/services/diabetes-education/s

Diabetes Affects Wound Healing

This dangerous combination could increase length of disability as well as your medical reserve!

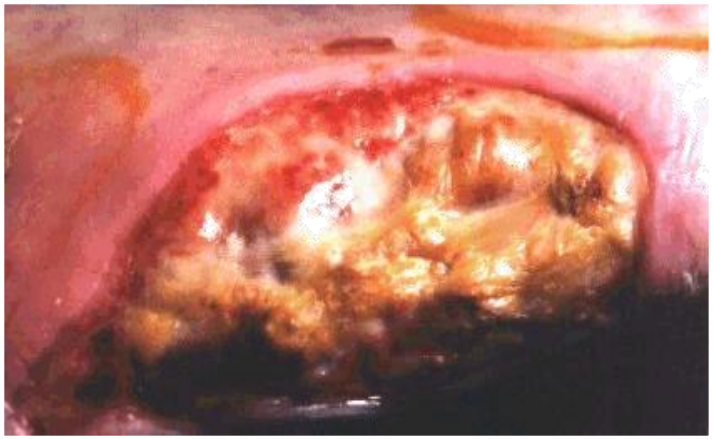
- Skin breaks & infections
- Decreased immunity
- Impaired sensation
- Poor blood flow

Source: Retrieved from www.woundcarecenters.org/article/living-with-wounds/how-diabetes-affects-wound-healing

Graphic Images Ahead

Healing Process

4-29-97
94 yr. old female
Right side/Right foot
Peripheral Vascular Disease 4.3x7 x 0.2 cm



6-30-97
94 yr. old female
Right side/Right foot
Peripheral Vascular Disease 1.8 x 5 cm

Diabetes Impact on Ankle Fractures

- Patients with diabetes – generally poor outcomes
- 42.3% incidence of complications (McCormick and Leith)
- 32% higher infection rate (Flynn, et. al.)
- Conservative management, preferable to surgical treatment
- Those treated conservatively – greater tendency to become infected versus those treated with open reduction internal fixation (ORIF)
- Those with poorly controlled diabetes and evidence of neuropathy – shown to be very difficult to manage

Diabetes Impact on the Heart

- Greater risk for heart disease, can lead to heart attack or stroke
  - Thicker vessels make it harder for blood to flow
  - Damaged vessels can lead to heart attack and stroke
  - Cardiac death rates 2 – 4x higher than non-diabetics
  - Incidence of stroke 2 – 4x higher in diabetic population and subsequent death, almost 3x higher
  - Heart disease and stroke: 65% of deaths in people with diabetes

- Controlling blood glucose levels, blood pressure and cholesterol can help decrease heart disease

Oxygen Therapy Chamber

- Most powerful and versatile agents
- Assist in the healing of wounds for ~40 years
- Hyperbaric Oxygen Chamber Therapy (HBOT); hypoxic or ischemic wounds
- Hypoxia: insufficient supply of oxygen occurs in patients with diabetes which prevents normal healing
- HBOT combats infections such as gangrene
- HBOT provides the oxygen needed to support and stimulate wound healing

Diabetes Impact on the Eyes

- **Diabetic Eye Disease –** may cause severe vision loss or blindness:
  - Cataract
  - Retinopathy
  - Glaucoma

- **Diabetics Retinopathy –** most common diabetic eye disease, leading cause of blindness in American adults
  - Blood vessels of retina may swell and leak fluid
  - Abnormal new blood vessels may grow on the surface of the retina
  - Detection is key!

Source: Retrieved from https://nei.nih.gov/health/diabetic/retinopathy-September 2015

Other Systematic Complications

- **Increased Risk for Depression** – 2x as likely to suffer from
  - Higher in women

- **Nervous System** – Excess glucose causes damage
  - 60-70% have mild to severe nervous system damage
    - Impaired sensation
    - Pain in hands & feet
    - Slow digestion
    - Carpal Tunnel Syndrome
    - Almost 30% of diabetics 40 years old or older have impaired sensations in the feet increasing the risk of injury and sometimes requiring amputation

Source: Retrieved from www.diabetes.org/living-with-diabetes/complications/mental-health/depression
Source: Retrieved from www.endocrineweb.com/guides/diabetic-neuropathy/diabetic-neuropathy-causes

Other Systematic Complications

Respiratory System

- More likely to succumb to pneumonia or influenza

Kidneys

- Diabetes: leading cause of kidney failure, 44% of new cases
- 44,000 diabetics/year begin dialysis for end-stage renal disease
- Blood vessels begin to leak, protein from blood is excreted in urine
- Eventually vessels collapse and failure begins

Feet

- Diabetes may damage nerves and vessels in feet
- Decreased circulation, numbness, burning, ‘pins and needles’ feeling
- Reduced feeling leads to increased the risk of injury
- Lack of blood flow – decreased healing, increased infection

Source: Retrieved from healthguides.healthgrades.com/take-charge-of-your-diabetes-treatment/how-diabetes-affects-your-lungs
Source: Retrieved from www.diabetes.org/living-with-diabetes/complications/kidney-disease-nephropathy
Source: Retrieved from www.endocrineweb.com/guides/diabetic-neuropathy/diabetic-neuropathy-causes

Other Systematic Complications

Skin

- Dryness
- Infection
- Increased urination and dehydration
- Nerves that control sweat glands can become damaged and your body will not sweat enough

Sexual Dysfunction

- Erectile dysfunction
- Inability to ejaculate

Source: Retrieved from www.diabetes.org/living-with-diabetes/complications/skin-complications
Source: Retrieved from www.diabetes.org/living-with-diabetes/treatment-and-care/men/erectile-dysfunction

Other Long Term Complications

- Atherosclerosis
- Diabetic Nephropathy
- Diabetic Neuropathy
- Hyperlipidemia
- Hypertension
- Peripheral Vascular Disease (PVD)

Source: Retrieved from www.diabetes.org/living-with-diabetes/complications

Treatment Considerations

Oxygen

- Powerful
- Versatile agent
- Used to assist in healing of wounds for more than 40 years

HBOT – therapeutic use of oxygen under pressure

- Treat hypoxic or ischemic wounds
- Hypoxia – insufficient supply of oxygen, prevents normal healing
- Combats infections acting on anaerobic bacteria
- Provides oxygen needed to support and stimulate wound healing

Source: Retrieved from www.hbot.com/faq 2017

Treatment Considerations for Injured Worker with Diabetes

- Strict metabolic control for patients with diabetes
- Bone fracture and poorly controlled diabetes – decreased bone formation and mechanical stiffness (Beam, et. al.)
- When blood glucose levels were tightly controlled, the fracture healing is similar to those patients without diabetes
- Conservative care for diabetics, e.g. extensive period of non-weight bearing (2x as long) for patients with diabetes
  - 6 weeks of non-weight bearing for patient without diabetes
  - 12 weeks of non-weight bearing for patient with diabetes

Treatment Considerations for Injured Worker with Diabetes

- Utilize casts: well padded or total contact
- Protect areas predisposed to irritation
- Frequently inspect areas underneath casts
- Instruct diabetic patients to protect contralateral extremity while wearing casts
- Wrap contralateral limb lightly in an elastic bandage up to the knee and utilize a pillow in between the legs during sleep
  - Avoid development of iatrogenic wounds
- Limit activity
- More difficult to manage longstanding diabetes patients

Nutrition is Key

Diabetes, Nutrition and Wound Healing

- Persistently elevated blood glucose levels impairs healing
- Difficult to heal wounds
- Increased cell wall rigidity & decreased perfusion
- This prevents adequate oxygen & nutrition to be delivered to the wound
- Immune function is also decreased contributing to poor wound healing
- Healing is delayed & medical costs rise

Diabetes, Nutrition and Wound Healing

- Chemotaxis is the process by which white cells are attracted to the site of an infection.
- Phagocytosis is the ingestion of bacteria by white cells.
- Both processes are important in controlling wound infections and are impaired in patients with diabetes if blood sugars are not controlled.
- Diabetic infections take longer to heal for this reason
- Patients with diabetes often have a progressive loss of lean body mass, which is replaced with a metabolically inactive fat mass.

Nutritional Plan (Diet)

- The Nutritional Plan (Diet):
  - control intake of sugar, fats and sodium under a nutritionist
- Help to control blood pressure levels, decreasing hypertension
- Educating both the patient & family

Nutritional Plan (Diet)

- The patient may need several sessions with a nutrition professional to understand the diet and how food intact affects their blood sugar
  - Not enough Carbs = Low Blood Sugar (Hypoglycemia)
  - Too many Carbs = High Blood Sugar (Hyperglycemia)
- Free sites for complete meal planning
- ADA (American Diabetes Association)

Nutritional Plan (Diet)

- Nutritional Therapy (Diet) should be discussed during each wound care visit
- Many different nutritional approaches to diabetes are available:
  - No concentrated sweets
  - Exchange system
  - Carb counting
  - Glycemic index
- Any system is good as long as it is followed
- The Nutritional Therapy (Diet) should be individualized

A carb is a carb is a carb – true but be careful!

- Simplest dietary approach
- Eliminates all concentrated sources of “sugary foods”
- Often in long-term care facilities
- The amount of carbs in meals and snacks is more important than type

Source: Retrieved from medlineplus.gov/diabeticdiet>revised

The Exchange System

- The Exchange System is more comprehensive diet approach grouping foods with similar nutrition profiles:
- Categorizes food into 3 main groups:
  1. Carbohydrates – starch, fruits, milk, vegetables, and “other” carbohydrate lists
  2. Meat and meat substitutes – includes very lean and lean meat exchange lists
  3. Fats
- Under “fruit choices” – both ½ cup applesauce and ½ medium banana equal 1 fruit exchange (60 calories, 15 g of carbs, no protein or fat)

Source: Retrieved from https://www.uaex.edu/publications/pdf/FSHED-86.pdf

Carbohydrate Counting

- Daily intake of carbohydrates must be consistent to avoid fluctuations in blood sugar
- Carbohydrate counting calculates the grams of carbohydrates in foods eaten during meals and snacks
- This is more mathematically involved diet and each patient needs to understand how much carb is in each food along with knowing the right portion amount

15gm of Carb = 1 slice of bread

Source: Retrieved from www.joslin.org/info/Carbohydrate_Counting_101

Each contain the same amount of carbohydrates – **portion control is key**

Carbohydrate Counting

- Starches and fruits – 15 grams of carbohydrates per serving
- Milk – 15 grams
- Non-starchy vegetables – 5 grams
- Meat and fast are not considered carbohydrates

Breakfast Example: 45 grams of carbs needed

- 1 serving of cereal (15 grams)
- 1 serving of milk (12 grams)
- 1 serving of sliced strawberries (15 grams)

Each cereal has a different portion size:

- ¼ cup of granola
- 1/3 cup of sugar-coated corn flakes
- 1 cup of unsweetened Cheerios
- 1 ¼ cups of puffed wheat

Source: Retrieved from www.joslin.org/info/Carbohydrate_Counting_101

Glycemic index (GI):

- ranks carbohydrate-rich foods by how much they raise blood glucose levels
- characterizes the postprandial glucose response of various foods relative to white bread (which has a GI of 100)

Example:

- Mixed-grained bread – low-GI food (GI of 64)
- Kaiser roll – high-GI good (GI of 104)
- Diabetic patients should select a diet of low-GI foods

Source: Retrieved from www.gisymbol.com/meal-plans-for-diabetes-and-pre-diabetes

Advancements

Service Dogs

Insulin Pumps

MiniMed 630G

OmniPod

Tandem t:slim X2

Continuous Glucose Monitoring (CGM)

Medtronic Guardian

Freestyle Libre

Dexcom g6

Source: Retrieved from www.medtronicdiabetes.com/.../guardian-connect-continuous-glucose-monitoring
Source: Retrieved from www.dexcom.com/G6-CG
Source: Retrieved from www.freestylelibre.us/CGM/Inf

Closed Loop The Next Step

Source: Retrieved from bigfootbiomedical.com

Oral Medications Type II

Options	Common Medication	How They Work
Sulfonylureas	Glucotrol and Glucotrol XL	Stimulate beta cells to release more insulin
Biguanides	Glucophage and metformin	Decrease amount of glucose produced by liver
Meglitinides	Prandin and Starlix	Stimulate beta cells to produce insulin
Thiazolidinediones	Avandia and ACTOS	Helps utilize insulin better and reduce glucose production in liver
DPP-4 inhibitors	Januvia and Onglyza	Block breakdown of GLP-1 decreasing BS levels
SGLT2 Inhibitors	Invokana and Farxiga	Blocks excess sugars excrete urine
Alpha-glucosidase inhibitors	Precose and Glyset	Help to block starches/sugars
Bile Acid Sequestrants	BAS and Welchol	Block LDL decreasing BS levels

Key: BS= Blood Sugar

Source: Retrieved from www.diabetes.org/living-with-diabetes/treatment-and-care/medication/oral-medications

Key Takeaways

- Identify early weather injured workers might have diabetes
- If so, use A1C tests to assess how well they're controlling their condition
  - Normal levels – may recover at similar rate to non-diabetic
  - High levels – may have issues with delayed healing and recovery
- Work with medical professionals to alleviate impact on claimant recovery
  - Wounds may heal slowly or may not heal – may require HBOT
  - Infections could occur and frequently recur – monitor
  - Conservative care for fractures, e.g. 2x as long non-weight bearing
  - Determine if experiencing other complications that could impact recovery and take these into account when developing treatment plan
  - Determine if nutritional counseling might benefit claimant recovery, as well as cost and duration of the claim

Thank you!

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