Diabetes, Sport & Diving

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1.1. Epidemiology

Hindus

Diabetes, Sport & Diving

- ✓Diabetes Mellitus
- ✓Diabetes & Sport
- ✓Diabetes & Diving

1.1. Epidemiology

Egypt

1. Diabetes Mellitus

- ✓Epidemiology
- ✓Glycaemia regulation
- ✓Definition
- ✓Types
- ✓Treatment
- ✓Complications

1.1. Epidemiology

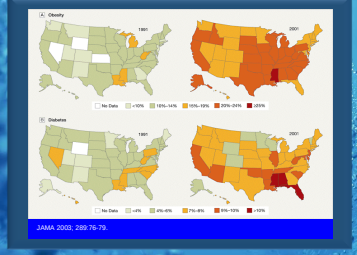
First observations

1.1. Epidemiology

First studies

- **Claude Bernard** (19th century) : studies of pancreas and liver.
- **Paul Langerhans** : dissection of pancreas – identification of 2 types of cells – the first ones produces « pancreatic juice » - the others ? – later identified and named « isleds of Langerhans ».

1.1. Epidemiology



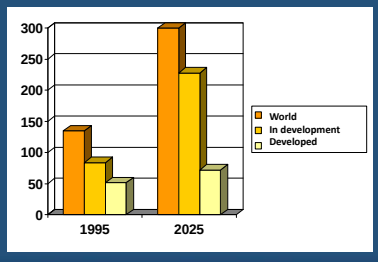
1.1. Epidemiology

First studies

- **Oskar Minkowski** & **Joseph von Mering** (1889) : first to isolate pancreas of dog to dertermine the effect of absence of pancreas on digestion.
- **Banting** et **Best** (1921) : discovery of insulin.

1.1. Epidemiology

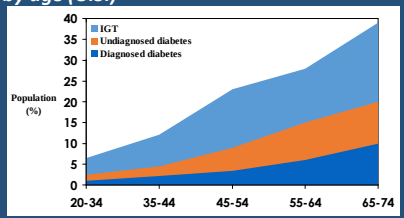
Prevalence Diabetes Type 2 – 1995-2025



1.1. Epidemiology

1.1. Epidemiology

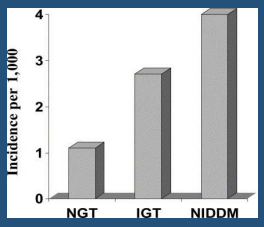
Diagnosed & Undiagnosed Diabetes & IGT by age (U.S.)



1.1. Epidemiology

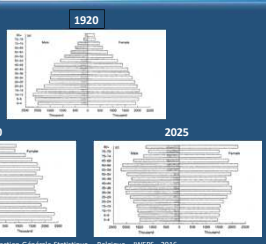
Mortality due to Coronary Artery Disease

NGT : Normal Glucose Tolerance
IGT : Impaired Glucose Tolerance
NIDDM : Type 2 Non-Isulin Dependent Diabetes Mellitus



1.1. Epidemiology

Belgium



Direction Générale Statistique – Belgique – IWEPS - 2016

1.1. Epidemiology

World

- 1998 : 143 Millions diabetics
- 2025 : 300 Millions diabetics
- > 2x increase last 100 years
- increase mainly type 2 diabetics
- 9 on 10 are type 2 diabetics
- causes : aging & unhealthy lifestyle

Diabetic Atlas – International Diabetic Federation

1.1. Epidemiology

Belgium

Diabetes Type 2

- 2018 : 8 % of population (**1 on 12** adults*)
- 2030 : 9,6 % of population (1 on 10 adults*)
- 1 on 3 diabetics unknown
- 2 to 6x increase in Turkish/Marocan origin
- 6 % of adult population in « grey zone » : pre-diabetic with high risk to develop type 2 diabetes in short period of time
- summary : 1 million of Belgian citizans with high blood sugar levels for prevention and treatment of diabetes or complications

*known & unknown diabetes

Belgian Diabetic Register – Belgian Diabetic Federation

1.1. Epidemiology

March 17th 2010

1.1. Epidemiology

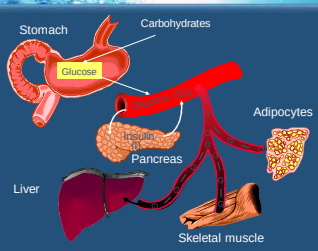
Belgium

Diabetes Type 1

- 0,4 % of total population or 40.000 belgian citizans
- no global trend of increase
- diagnosed mostly under the age of 40 years
- diagnosed younger and younger
- 10 new type 1 diabetics < 40 years / 100.000 citizans / year

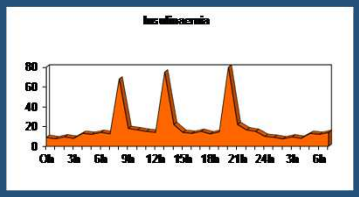
Belgian Diabetic Register – Belgian Diabetic Federation

1.2. Glycaemia regulation



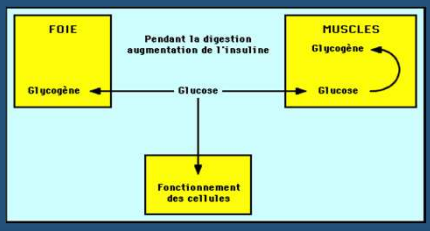
1.2. Glycaemia regulation

Physiological Insulin Secretion



1.2. Glycaemia regulation

Post-prandial glycaemia regulation



1.3. Definition (1)

2005 Criteria for Diagnosis of Diabetes Mellitus

- ***Symptoms of diabetes plus casual plasma glucose ≥ 200 mg/dl.*** *Casual is defined as any time of day without regard to time since last meal. The* ***classic symptoms*** *of diabetes include* ***polyuria, polydipsia, and unexplained weight loss.***

  OR
- ***FPG ≥ 126 mg/dl.*** *Fasting is defined as no caloric intake for at least 8 hrs.*

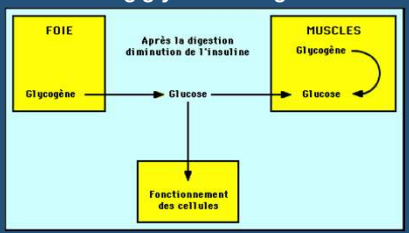
  OR
- ***2-h postload glucose ≥ 200 mg/dl during an OGTT*** *performed as described by WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.*

In the absence of unequivocal hyperglycemia, these criteria should be confirmed by repeat testing on a different day. OGTT is not recommended for routine clinical use.

Diabetes Care 2005; 28:537-542

1.2. Glycaemia regulation

Fasting glycaemia regulation



1.3. Definition (2)

Impaired Glucose Intolerance (IGT) & Impaired Fasting Glucose (IFG) – Pre-Diabetes

- ***Pre-diabetes*** *: Glucose is too high for normal but not diagnostic for diabetes; risk factor for developing diabetes*
- ***Categories*** *for* ***fasting plasma glucose*** *(****FPG****) values:*
  - *FPG < 100 mg/dl = normal fasting glucose*
  - ***FPG 100-125 mg/dl = impaired fasting glucose (IFG)***
  - *FPG ≥ 126 mg/dl = provisional diagnosis of diabetes (unconfirmed)*
- ***Categories*** *for* ***2-h postload glucose*** *values from* ***OGTT*** *:*
  - *2-h glucose < 140 mg/dl = normal glucose tolerance*
  - ***2-h glucose 140-199 mg/dl = impaired glucose tolerance (IGT)***
  - *2-h glucose ≥ 200 mg/dl = provisional diagnosis of diabetes*

Diabetes Care 2005; 28:537-542

1.4. Types

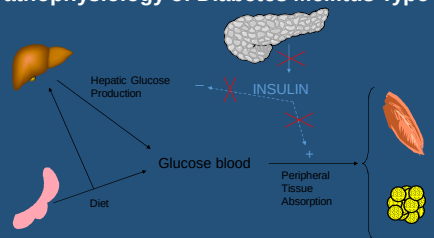
Diabetes Mellitus Type 1 versus Type 2

TYPE 1

TYPE 2

1.4. Types

Pathophysiology of Diabetes Mellitus Type 2



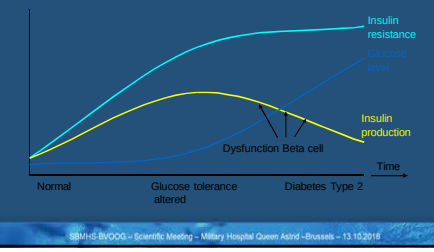
1.4. Types

Diabetes Mellitus Type 1 versus Type 2

Type (frequency)	1 (< 10%)	2 (> 90%)
Onset	< 40 ya	> 40 ya
Acido-ketose	Yes	No
Weight	Mostly thin	80% ovrweight
Cause	Autoimmune or unknown	No auto-immunity markers

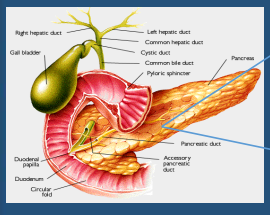
1.4. Types

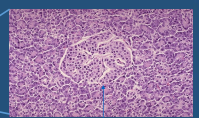
Natural history of Diabetes Mellitus Type 2



1.4. Types

Pathophysiology of Diabetes Mellitus Type 1

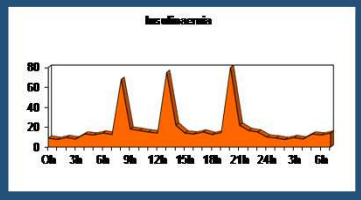




Destruction of islets of Langerhans by antibodies

1.5. Treatment

Physiological Insulin Secretion



1.5. Treatment




Insuline – Different administration forms

- ✓ Injection
- ✓ Stylo
- ✓ Pump
- ✓ Inhaled form (dry pouder)
- ✓ Oral form*

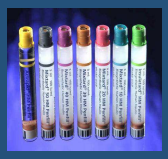
* under development

1.5. Treatment

Insuline – Pump

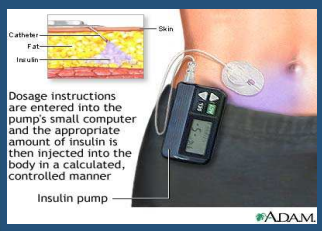
1.5. Treatment

Insuline – Stylo



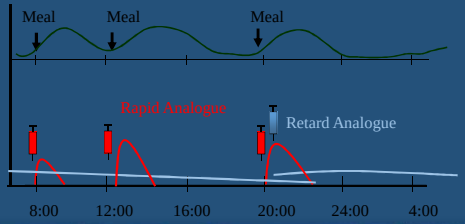

1.5. Treatment

Insulin pump



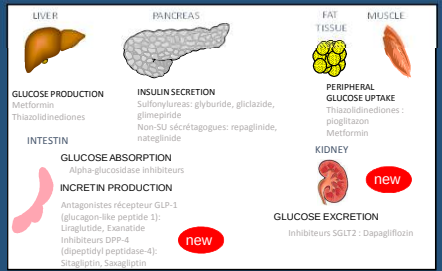
1.5. Treatment

Treatment optimized with 4 injections



1.5. Treatment

Oral Treatments



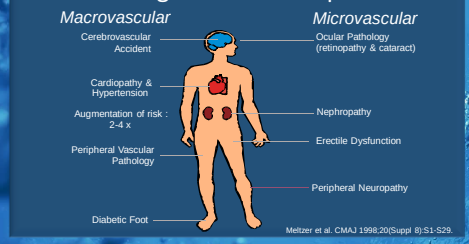
1.6. Complications

Acute metabolic complications

1. Hypoglycaemia
2. Diabetic ketose and acido-ketose

1.6. Complications

Chronic degenerative complications



1.6. Complications

Hypoglycaemia

✓**decrease of glycaemia** below 0,6 g/L (3,3 mmol/L)

✓associated with **clinical signs**, different and non specific, variable from one subject to another, but mostly similar for the same subject

✓short term risk (if no corrective actions) : **loss of consciousness** and **hypoglycaemic coma** (the brain is consuming mostly only glucose)

2. Diabetes & Sport

- ✓ How exercise helps people with diabetes
- ✓ What happens during exercise
- ✓ Getting ready to exercise
- ✓ Exercise tips for people with diabetes
- ✓ What to watch out for

1.6. Complications

Diabetic ketosis and acido-ketosis

- ✓ **glucose** : normal energy source
- ✓ **fat** : rescue energy source producing acid waste
- ✓ **aceton** : control of usage of fat and procution of acid wast
- ✓ **acid waste** : perturbate cellular function with risk of **coma**

2.1. How exercise helps diabetics

Exercise offers many benefits. It:

- ✓ strengthens **bones** and **muscles**
- ✓ reduces your **risk of heart disease** and **some types of cancer**
- ✓ improves **coordination**, **balance**, **strength** and **endurance**
- ✓ can increase your **energy level**
- ✓ helps **insulin** work better in the body, which helps **blood sugar** levels stay in a healthy range
- ✓ burns **calories**, which helps you reach and stay at a **healthy weight**
- ✓ teaches you about **teamwork**, **competition**, and **courage**
- ✓ helps boost **self-esteem** and **confidence**
- ✓ relieves **tension** and **stress**, **relaxes** you, and boosts your **mood** too
- ✓ can even help you clear your **mind** and focus your **attention** better

2.1. How exercise helps diabetics

Sport and diabetes :

- increases **insuline sensitivity**.
- helps to control **body weight**.
- has a positive effect on **cholesterol** and **fat level**.
- is beneficial against **stress** and **depression**.
- increases **psychological well-being**.
- stimulates **blood circulation**.
- strengthes **muscles** and **bones**.

2.3. Getting ready to exercise (1)

Before starting sport :

- Discusion with **treathing physician**
- **Sports medical fitness exam** has to be performed
- Age, condition and eventual limitations will determine fitness for **type of sport**
- Duration, intensity and frequency has to be **build up gradually**

2.1. How exercise helps diabetics

30 minutes of sports activities per day will :

- ✓ decrease **blood pressure**
- ✓ decrease **cardiovascular risk**
- ✓ decrease **weight**
- ✓ decrease **HbA1c**
- ✓ increase **muscle mass**
- ✓ decrease **fat mass**

2.3. Getting ready to exercise (2)

Sport or no sport :

- If glycaemia : 150-200 mg/dL = ok sport
- If glycaemia : < 150 mg/dL = first intake of slow carbohydrates
- If glycaemia : < 70 mg/dL = hypo glycemia – first intake of fast carbohydrates, then slow carbohydrates, ok sport if glycemia ok
- If glycaemia : 200-250 mg/dL = ok, but mandatory measurment of glycemia after 1 hour + correction if needed
- If glycaemia : > 250 mg/dL = no sport, corection and sport if < 250 mg/dl
- If presence of ketones = no sport

2.2. What happens during exercise

The muscles need more energy during exercise, so the body releases extra sugar, or glucose. For people with diabetes, this can have some side effects. For example, if the body doesn't have enough insulin to use the glucose that's released during exercise, then the glucose stays in the blood, which leads to high blood sugar levels. This is called hyperglycemia.

Not having enough insulin to use the sugar in the blood can also cause the body to burn fat for fuel. When the body starts to burn fat for fuel, substances called ketones are produced. People with diabetes shouldn't exercise if they have high levels of ketones in their blood because this can make them really sick. If you have type 1 diabetes, your doctor will tell you how to check for ketones (you may need to take a urine test before exercising) and treat yourself to get back on track.

The body's need for extra glucose during exercise can also cause low blood sugar levels, called hypoglycemia. Low blood sugar can happen when the body uses up all the sugar that it's stored so there's no more to be released as glucose when the muscles demand it. This is especially true if insulin levels in the blood are still high after taking an injection.

You may need to check blood sugar levels and have an extra snack to prevent low blood sugar levels. If you're starting a rigorous exercise schedule, like training for a sport, your doctor may recommend that you adjust your insulin dosage to prevent low blood sugar levels.

2.3. Getting ready to exercise (3)

No sport :

- If glycaemia > 250mg/dL
- If presence of ketones
- If sick
- If pain or thoracic opression during exercise
- If dyspnea
- If negative advise of treathing physician

2.4. Exercise tips for diabetics (1)

These tips can help you avoid diabetes problems during exercise :

- ✓ **Test yourself.** Your doctor will tell you when to test your glucose levels — often you'll need to check them before, during, and after exercise.
- ✓ **Take the right dose of insulin.** Your doctor might recommend adjusting your insulin dosage for exercise or sports. If you inject insulin, you might not want to inject a part of your body used for your sport before exercise (like injecting your leg before soccer). This could cause the insulin to be absorbed too quickly. If you wear an insulin pump, be sure that it won't be in the way for exercise and that it won't get disconnected. Talk to your doctor about what you should do when you want to go without the pump.
- ✓ **Eat right.** Your diabetes health care team will also help you adjust your meal plan so you have enough energy for exercise. For example, you might need to eat extra snacks before, during, or after working out. Be sure to maintain the proper diet for your diabetes — don't try strategies like loading up on extra carbs before running or cutting back on food or water to get down to a certain weight for wrestling. These activities can be dangerous for people with diabetes.

2.5. What to watch out for

If you notice any of the signs listed below, stop exercising and follow your diabetes management plan.

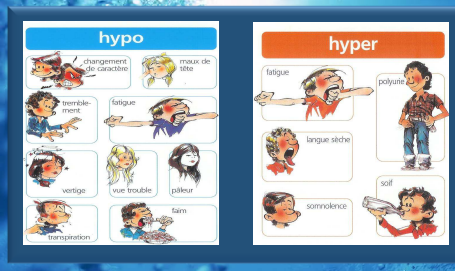
- ✓ You may have low blood sugar if you are:
  - sweating
  - lightheaded
  - shaky
  - weak
  - anxious
  - hungry
  - having a headache
  - having problems concentrating
  - Confused
- ✓ You may have high blood sugar if you:
  - feel very thirsty
  - have to pee a lot
  - feel very tired
  - have blurry vision

2.4. Exercise tips for diabetics (2)

These tips can help you avoid diabetes problems during exercise :

- ✓ **Bring snacks and water.** Whether you're playing football at the school or swimming in your backyard, keep snacks and water nearby.
- ✓ **Pack it up.** If you'll be exercising away from home, pack your testing supplies, medications, medical alert bracelet, emergency contact information, and a copy of your diabetes management plan. Keep these items in a special bag that you don't have to pack and repack every time you go out.
- ✓ **Tell your coaches.** Be sure that your coaches know about your diabetes. Tell them about the things you need to do to control diabetes that might happen before, during, or after a game.
- ✓ **Take control.** Don't hesitate to stop playing or take a break in your exercise routine if you need to eat a snack, drink water, go to the bathroom. You should also take a break if you feel any signs that something is wrong.

2.5. What to watch out for



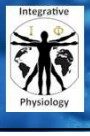
2.4. Exercise tips for diabetics (3)

Some additional practical tips :

- Neem steeds druivensuiker of andere snelle suikers mee tijdens het sporten.
- Zorg voor voldoende vochtinname.
- Controleer steeds de glycemie voor het sporten.
- Voor de geplande sportactiviteit vermindert u uw insuline dosis en/of neemt u meer koolhydraten in.
- Zorg voor goede sportschoenen en controleer uw voeten.
- Breng uw medesporters op de hoogte van uw diabetes en en vertel hen wat men best doet in geval van een hypoglycemie.
- Indien u alleen gaat sporten, breng steeds iemand op de hoogte van uw route, tijdstip van vertrek en geplande duur van de activiteit (bijv door een nota thuis achter te laten).
- Meet de glycemie na het sporten (handen wassen! Transpiratie kan een vals verlaagde glycemiemeting opleveren).
- Onmiddellijk na het sporten kan de glycemie verhoogd zijn. Dit komt door verhoging van de stresshormonen in uw bloed. Dien **NIET** onmiddellijk een correctiebolus toe. De spieren moeten immers hun glucosevoorraad terug aanvullen en halen glucose weg uit het bloed. Na het sporten kan je glycemie dus nog sterk dalen.
- Sla geen maaltijd over na het sporten. De maaltijdbolus kan u eventueel ook nog wat verminderen.
- En het allerbelangrijkste: Zorg dat u plezier beleeft aan uw sportactiviteit!

3. Diabetes & Diving





- ✓ History
- ✓ Guidelines
- ✓ Issues
- ✓ Future
- ✓ Summary

3.1. History

- In late 1960s, divers with diabetes allowed to dive
- In mid-1970s diver with type 1 diabetes surfaced after an uneventful, non-provocative dive on the *Persier* wreck
- Went on to have spinal DCI
- Treated for hypoglycaemia rather then recompressed (symptoms mistaken for hypoglycaemia)
- Diver became paraplegic then committed suicide
- Widow sued British Sub-Aqua Club (BSAC) and hospital
- BSAC banned all newly-diagnosed diabetics from diving in line with most other diving agencies worldwide

3.2. Guidelines for Recreational Diving (1)

Selection and Surveillance

- **Age ≥18 years (≥16 years if in special training program)**
- **Delay diving after start/change in medication**
  - 3 months with oral hypoglycemic agents (OHA)
  - 1 year after initiation of insulin therapy
- No episodes of hypoglycemia or hyperglycemia requiring intervention from a third party for at least one year
- No history of hypoglycemia unawareness
- HbA1c ≤9% no more than one month prior to initial assessment and at each annual review
  - values >9% indicate the need for further evaluation and possible modification of therapy
- No significant secondary complications from diabetes
- Physician/Diabetologist should carry out annual review and determine that diver has good understanding of disease and effect of exercise
  - in consultation with an expert in diving medicine, as required
- Evaluation for silent ischemia for candidates >40 years of age
  - after initial evaluation, periodic surveillance for silent ischemia can be in accordance with accepted local/national guidelines for the evaluation of diabetics
- Candidate documents intent to follow protocol for divers with diabetes and to cease diving and seek medical review for any adverse events during diving possibly related to diabetes

3.1. History

- Post-mortem on the diver's heart showed he had a large PFO
- Likely cause of DCI was gas embolus, not diabetes
- BSAC medical committee in 1991 formulated rules for diving with diabetes, published in *DIVER* 1992, vol 37 pp 35-36 and subsequently adopted by UHMS/DAN "*diabetes and recreational diving: guidelines for the future*" (2005)
- Australian Diabetes Society published position statement "Insulin-requiring diabetes and recreational diving" in 2016
- Set up a database for divers with diabetes to monitor safety and problems with diabetic divers with ethical approval
- Aim to establish whether divers with diabetes could dive safely on normal club dives in UK without intensive glucose monitoring such as performed at Camp DAVI in Virgin Is. (Steve Prosterman) where blood glucose is measured up to 15 times/day under medical supervision

3.2. Guidelines for Recreational Diving (2)

Scope of Diving

- Diving should be planned to avoid
  - depths >100 fsw (30 msw)
  - durations >60 minutes
  - compulsory decompression stops
  - overhead environments (e.g., cave, wreck penetration)
  - situations that may exacerbate hypoglycemia (e.g., prolonged cold and arduous dives)
- Dive buddy/leader informed of diver's condition and steps to follow in case of problem
- Dive buddy should not have diabetes

3.1. History

- In early 2003, 75% of diabetic divers registered with the database had type I diabetes and 25% were taking oral hypoglycaemic agents or were controlled on diet alone. The mean age for the type I group was 34 whilst that of the type II group was 47
- The main concern was hypoglycaemia both in the type I and type II groups – a common oral agents at the time were sulfonylureas, some of which acted over a period of hours
- Divers taking insulin or oral hypoglycaemic agents are encouraged to measure their blood glucose levels just before diving and to ensure that they are slightly elevated

3.2. Guidelines for Recreational Diving (3)

Glucose Management on the Day of Diving

- General self-assessment of fitness to dive
- **Blood glucose (BG) ≥150 mg·dL-1 (8.3 mmol/L), stable or rising, before entering the water**
  - complete a minimum of three pre-dive BG tests to evaluate trends
    60 minutes, 30 minutes and immediately prior to diving
  - alterations in dosage of OHA or insulin on evening prior or day of diving may help
- Delay dive if BG
  - <150 mg/dL (8.3 mmol/L)
  - >300 mg/dL (16.7 mmol/L)
- Rescue medications
  - carry readily accessible oral glucose during all dives
  - have parenteral glucagon available at the surface
- If hypoglycemia noticed underwater, the diver should surface (with buddy), establish positive buoyancy, ingest glucose and leave the water
- Check blood sugar frequently for 12-15 hours after diving
- Ensure adequate hydration on days of diving
- Log all dives (include BG test results and all information pertinent to diabetes management)

Pollock NW, Uguccioni DM, Dear GdeL, eds. Diabetes and recreational diving : Guidelines for the future. Proceedings of the UHMS/DAN 2005 June 19 Workshop. Durham, NC: Divers Alert Network; 2005.

3.3. Issues

ACUTE ISSUES

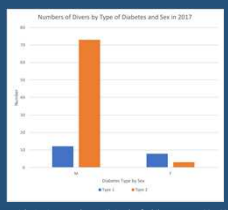
First

- ✓ Glycaemic control in **type I diabetes**:
  - Dealing with in-water hypoglycaemia
  - Long-acting insulin
  - Insulin pumps
  - Adolescents, "pushy" parents, "know-all" diabetes consultants

3.3. Issues

CHANGING NATURE OF DIABETIC POPULATION

- In 2017 fewer females with diabetes than males register with the database.
- Ratio of type 1 diabetes to type 2 diabetes is reversed in females in the database.



UK Diabetic Divers Database – Chris Edge & Phil Bryson – TRICON 2018

3.3. Issues

LONG TERM ISSUES

Later

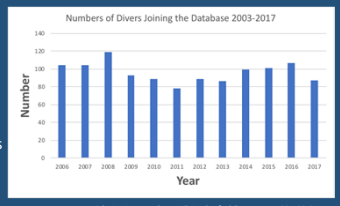
- ✓ Long-term complications in **diabetes type 1 & 2**:
  - Cardiovascular
  - Renal
  - Neuropathies – autonomic – sensory

3.3. Issues

DO ALL DIVERS WITH DIABETES REGISTER WITH THE DATABASE?

NO.
Why not?

- Standard problem with self-reporting questionnaires
- Some divers only train with, and dive with overseas schools – never train or join a club in the UK



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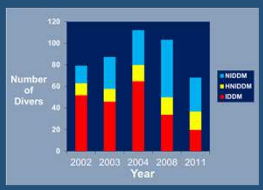
3.3. Issues

CHANGING NATURE OF DIABETIC POPULATION

- In 2017 much more concern regarding **long-term complications** of diabetes.
- Many of the **modern drugs** used to control type II diabetes are **unlikely to cause hypoglycaemia.**
- **Lack** of **appreciation of complications** of diabetes by doctors and diabetic population.



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3.3. Issues

TYPE 2 DIABETES

- Long-term complications:
  - Autonomic/sensory neuropathy
  - Erectile dysfunction
  - Cardiovascular disease
  - Renal disease
- "If the pattern of the heart beat becomes as regular as the tapping of a woodpecker or the dripping of rain from the roof, the patient will be dead in four days"

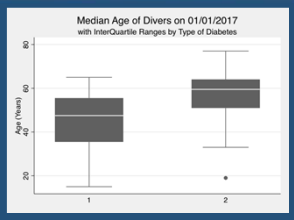
Wang Shuhe (265-317 AD) *The Pulse Classic*

Doctor Wang Shuhe writing *The Pulse Classic*
From: Liu YC. *The Essential Book of Traditional Chinese Medicine*.
New York: Columbia University Press, 1988.

3.3. Issues

OTHER PROBLEMS …

- Age and lack of fitness.
- Scuba diving is not perceived to be a sport in which the diver has to be particularly fit.
- Additionally the diving population is aging and divers present with other medical problems



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3.3. Issues

TYPE 2 DIABETES AND THE 'OLDER' DIVER

- Persons with type 2I diabetes tend to be physiologically older (~8 years for persons aged 55-64) than their non-diabetic age group.
- Opportunity to pursue "healthier lifestyle" options for the diver and to ensure that their diabetes is being treated adequately and that HbA_{1c} is not unduly elevated.
- Review of existing medications – are they compatible with diving?
- Review of regular exercise undertaken by diver to help contribute to diver fitness in the water.

Ulrich P, Cerami A. *"Protein glycation, diabetes, and aging"*. Recent Prog Horm Res. 2001;**56**(1):1-21
Aronson D. *"Cross-linking of glycated collagen in the pathogenesis of arterial and myocardial stiffening of aging and diabetes"*. J Hypertens 2003;**21**(1):3-12

3.3. Issues

TYPE 2 DIABETES

- A "older" diver with newly-diagnosed type II diabetes seeks a medical from a diving physician.
- Minimal advice on type II diabetes in Bove & Davis' "*Diving Medicine*" (4th ed. 2003).
- Type II diabetes mentioned infrequently in "The Diving Medicine Bible" Edmonds, Bennett, Lippmann and Mitchell "*Diving and Subaquatic Medicine" (5th ed. 2015).*
- Prevalence of complications of type II diabetes in patients aged 25-65 on diagnosis given by the UK Prospective Diabetes Study Group in Diabetologia 1991;**34**:877-890.

3.3. Issues

CARDIAC AUTONOMIC NEUROPATHY

- Clinical manifestations are resting tachycardia, exercise intolerance, orthostatic hypotension and silent myocardial infarction
- Very under-diagnosed, progressive condition associated with poor outcomes
- Prevalence is 17-66% in patients with type I diabetes and 31-73% in patients with type II diabetes (incidence/annum 6% and 2% respectively)
- Intensive glycaemic control can decrease CAN by 50% over 6.5 years

Pop-Busui R, Low PA, Waberski BH *et al. "Effects of prior intensive insulin therapy on cardiac autonomic nervous system function in type 1 diabetes mellitus: the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications study (DCCT/EDIC)"*
Circulation 2009;**119**(22):2886-2893
Ewing DJ *et al. "The value of cardiovascular autonomic function tests: 10 years experience in diabetes."*
Diabetes Care 1985;**8**(5):491-498

3.3. Issues

LONG TERM COMPLICATIONS TYPE 1 & 2 DIABETES

Tissue Damage	Prevalence at Diagnosis (%)
Retinopathy (>1 microaneurysm)	21
Abnormal ECG	18
Myocardial Infarct	2
Angina Pectoris	3
Intermittent Claudication	3
Stroke/TIA	1
Absent foot pulses (>2) or ischaemic feet	14
Impaired reflexes and/or decreased vibration sense	7
Erectile dysfunction	35-90

3.3. Issues

COMMERCIAL DIVERS & DIABETES

- ✓ Recreational instructors and DiveMasters
  - ✓ In UK have a "duty of care" under Health & Safety at Work (etc) Act 1974 and subsequent Approved Codes of Practice (ACOPS)
  - ✓ Instructors with type I or type II diabetes allowed to dive provided:
    - ✓ Have been diving with the condition for at least one year
    - ✓ Can demonstrate good control of blood glucose levels before and after every dive
    - ✓ Diving Officer of club is happy for them to be instructors
    - ✓ They don't dive with other divers with diabetes
- ✓ Saturation divers
  - ✓ **Not allowed** – have had four cases where divers have had genetic disposition to diabetes (MODY) or have concealed diabetes & have gone on to develop diabetes in saturation or situations where medical assistance could not be rapidly provided

3.4. Issues

YOUNG PERSONS < 18 yo & DIABETES

- ✓ Controversial
  - ✓ Not currently allowed in UK as diabetic control usually poor with multiple hypoglycaemic attacks
  - ✓ Difficult in UK conditions to measure blood glucose sufficiently often to ensure that diver doesn't become hypoglycaemic
  - ✓ Pressure from "pushy" parents and diabetes consultants

3.6. Summary

- Numbers of divers with type II diabetes increasing as population becomes older/fatter
- Opportunity for diving physicians to contribute to getting this population fitter/healthier using carrot/stick approach ("control your diabetes better or no diving")
- Tests for CAN easy to carry out with single channel ECG/sphygmomanometer/finger on pulse
- Requires further education of diving physicians/occupational physicians regarding CAN and prevalence of complications in type II diabetes
- Divers with diabetes can dive safely in open water **provided** no long-term complications **and** well-controlled

3.5. Future

INSULINE PUMPS

- None so far manufactured that are certified to function at > 2 bar abs pressure
- Variable absorption of insulin at pressure and with cold water
- Current advice is to switch to insulin injections when diving and ensure slight hyperglycaemia before commencing dive

3.6. Summary

WOULD BE HELPFUL TO MOVE FORWARD ON A WORLDWIDE BASIS

- Anonymised database of divers with diabetes
- Have to get "buy-in" from the diving industry – difficult for commercial reasons
- Require administrative assistance to run such a programme
- Funding might come eventually if diabetic divers start to have more problems in the water as a result of inadequate screening before starting diving

3.5. Future

IMPLANTABLE GLUCOSE SENSORS

- Many different types of sensor
  - Most are enzymatically based
  - More modern technology is boronic acid based
- Any sensor must be accurate, specific for glucose, have real-time detection and be accurate under pressure
- Enzymatic sensors have been shown to be inaccurate under pressure

Edge CJ *et al* "*Effects of pressure on whole blood glucose measurements using the Bayer Glucometer 4 blood glucose meter*" Undersea Hyperbar Med **1996;23**(4):221-224

Diabetes, Sport & Diving

Thanks for your attention

(hopeful not too hypoglycemic)