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Association of Hong Kong Diabetes Nurses

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Editorial

Technological innovation in medicine covers diabetes technologies function in a multitude of ways with the potential to greatly reduce disparities in outcomes by improving quality of nursing care, reducing diabetes distress, improving quality of life of our patients, and optimizing diabetes self-management to improve health outcomes. In view of the benefit of improving our care, we are glad to invite endocrinologists and diabetes nurses to introduce and share experience in new technology, including biogenetic markers of DM, experience on Tele-Health, update on continuous glucose monitoring and insulin-induced lipohypertrophy.

Biogenetic markers in precision diabetes care

Dr. Andrea Luk

Precision medicine is about providing the right therapy for the right person at the right time.

Research into precision medicine in diabetes has gained momentum in recent years. Scientists are making inroads into understanding the complexity of diabetes, advancing our knowledge on how genetic, environment, behaviour and age interact and contribute to development of this condition. As new biogenetic markers and technology are being developed that allow us to assess aspects of disease biology beyond blood glucose, we are in a better position to apply precision medicine in ways not previously possible. With emergence of new pharmacotherapeutics for treatment of people with diabetes, it becomes more important than ever before that we are able to prescribe medicine tailored to the individual according to their distinct underlying disease processes.



In 2018, the American Diabetes Association in partnership with the European Association for the Study of Diabetes established the Precision Medicine in Diabetes Initiatives (PMDI) with the aims to assess existing evidence on precision medicine in diabetes management and to identify gaps in evidence where additional work is needed to support implementation of precision medicine. The Initiative defines precision medicine in diabetes as “an approach to optimise the diagnosis, prediction, prevention and treatment of diabetes by

integrating multidimensional data to account for individual differences". Multidimensional data include simple clinical features, biomarkers, genetic data, multi-omic data, and continuous data collected from wearable devices. At the time of writing, the PMDI has published its second consensus report summarising the key findings of systematic reviews conducted by the PMDI consortium.

This article discusses the clinical application of currently available biogenetic markers including C-peptide, anti-islet antibodies, genetic sequencing for monogenic diabetes, and polygenic risk scores, in people with diabetes.

C-peptide

C-peptide is part of proinsulin and is released by pancreatic beta-cells in equimolar quantity to insulin. Compared with insulin, degradation rate of C-peptide is slower and more stable, making serum C-peptide a preferred measurement to serum insulin in the assessment of endogenous insulin secretion. C-peptide is cleared by the kidney, and serum C-peptide levels may be elevated in individuals with impaired kidney function. Stimulated C-peptide using glucagon-stimulation test or mixed meal tolerance test are considered the "gold standard" for evaluation of insulin secretion but infrequently used outside research setting. Serum C-peptide levels collected at fasting or random have both been shown to correlate with stimulated C-peptide. In Hong Kong, most laboratories use chemiluminescence immunoassays to measure C-peptide levels. However, significant assay discrepancies exist, resulting in C-peptide levels not being directly comparable if measured in different laboratories.

Serum C-peptide levels can be used to differentiate diabetes subtypes, namely type 1 diabetes, type 2 diabetes and maturity-onset diabetes of the young (MODY), when the diagnosis is uncertain on clinical ground. Fasting C-peptide level below 80 pmol/L or random C-peptide level below 200 pmol/L indicates insulin deficiency and confirms type 1 diabetes. Of note is that individuals with type 1 diabetes may have preserved insulin secretion in the initial 1-3 years from diagnosis and therefore C-peptide level may still be detectable during this time.

There are other considerations when interpreting C-peptide levels. Firstly, release of insulin and C-peptide is sensitive to concurrent blood glucose levels. C-peptide levels will be low when blood glucose is in the hypoglycaemic range. Some researchers proposed using C-peptide-to-glucose ratio which makes adjustment for concurrent blood glucose values. Secondly, C-peptide levels will increase as a result of insulin resistance, reflecting compensatory response of beta-cell to increase insulin secretion to maintain euglycaemia. Homeostasis assessment model-2 (HOMA2) is a mathematical model to estimate beta-cell function and hepatic insulin sensitivity during steady state using fasting glucose and fasting C-peptide. HOMA2 calculator is free to download: https://www.dtu.ox.ac.uk/homacalculator/

Apart from diagnostic, C-peptide measurements may be used to identify patients for initiation or withdrawal of insulin therapy. Low C-peptide level predicts need of insulin therapy especially in patients failing several non-insulin glucose-lowering drugs. In a longitudinal cohort of 610 Hong Kong Chinese with type 2 diabetes with median follow-up of 9 years, those with insulin insufficiency defined as HOMA2-%B below median, were 3- to 4-fold more likely to have glycaemic deterioration and require insulin therapy. Conversely, high C-peptide level predicts success of insulin withdrawal in insulin-treated patients with type 2 diabetes, thus allowing us to identify insulin-treated patients with preserved beta-cell function to safely replace insulin with other therapies.

Anti-islet antibodies

Anti-islet antibodies are antibodies that target antigens within the beta-cell and are markers of immune-mediated diabetes. There are four major anti-islet antibodies, including anti-glutamic acid decarboxylase (GAD), tyrosine phosphatase-related islet antigen-2 (IA-2A), zinc transporter 8 (ZnT8), and (pro)insulin (IAA) antibodies. Anti-GAD antibody is the most commonly measured anti-islet antibodies because it is most likely to be positive among people with immune-mediated diabetes and persist in the circulation longest.

Presence of anti-islet antibodies in people with diabetes confirm immune-mediated cause, either type 1 diabetes or latent autoimmune diabetes of adults (LADA). LADA, also termed "slowly evolving immune mediated diabetes of adults" by the World Health Organisation, is a hybrid of immune-mediated and type 2 diabetes. Clinically, LADA runs an indolent course indistinguishable from type 2 diabetes. Unlike type 1 diabetes, patients with LADA do not present with diabetic ketoacidosis and may not require insulin therapy initially. Although patients with LADA are generally leaner than their counterparts with type 2 diabetes, over half are overweight or obese and have other cardio-metabolic risk factors. Diagnosis is based on positive anti-GAD or other anti-islet antibodies. In a study of 1,504 Hong Kong Chinese with young-onset non-type 1 diabetes, 8% were positive for anti-GAD confirmatory of LADA. Notably, glycaemic response to insulin and other glucose-lowering therapies differ between patients with LADA and type 2 diabetes. In a 12-month observation of Hong Kong Chinese newly initiated on insulin therapy, HbA1c declined by 2.3% in those with LADA versus only 0.7% in those with type 2 diabetes. Other studies suggested that sulphonlyureas could accelerate decline in beta-cell function whereas dipeptidyl-peptidase-4 inhibitors could stablise beta-cell function in patients with LADA.

Genetic sequencing for monogenic diabetes

Monogenic diabetes arises from mutations in genes that regulate beta-cell function or insulin action. Inheritance is predominantly autosomal dominant but in some cases, monogenic diabetes can be inherited in an autosomal recessive manner or arise de novo. To date, over 40 genes have been implicated to cause monogenic diabetes. MODY is the most common presentation of monogenic diabetes. Clinical course varies depending on MODY subtypes, ranging from mild hyperglycaemia with minimal risks of complications (e.g. glucokinase [GCK] MODY), to the more severe forms with early manifestation of microvascular diseases (e.g. hepatic nuclear factor 1B [HNF-1B]) MODY). Importantly, response to treatment also differ by MODY subtype. For instance, patients with GCK MODY do not require glucose-lowering therapy although there is special obstetric consideration for mother or father with GCK MODY. On the other hand, patients with transcription factor MODY respond well to low dose sulphonlyureas, which should be prescribed as first-line therapy to these individuals. The diagnosis of monogenic diabetes also has implication for family members who are at risk of carrying the mutation and developing diabetes.

The prevalence of monogenic diabetes is approximately 2-3% in Hong Kong Chinese with young-onset diabetes. Diagnostic confirmation requires sequencing of known monogenic diabetes genes using Sanger sequencing or next-generation sequencing. Current practice guideline recommends MODY screening in individuals with early diabetes onset, parental history of diabetes, are non-obese, and not insulin-dependent. Efficient case finding is however limited by many overlapping features between MODY and type 2 diabetes. From the Hong Kong Diabetes Registry, 20% of patients with diabetes were diagnosed before the age of 40

years, 30% of whom were lean and 60% reported having an affected family member. Conventional selection criteria for genetic sequencing therefore have low differentiating value resulting in many people not being tested. Indeed, over 80-90% of patients with MODY remain undiagnosed. The Hong Kong Hospital Authority has recently set up clinical genetic and genomic service for people suspected to have genetic conditions including monogenic diabetes. Widened availability of genetic sequencing in the public sector should hopefully broaden awareness of monogenic diabetes among healthcare workers and enable more patients to be screened and diagnosed.

Polygenic risk scores and prediction of type 2 diabetes and complications

Type 2 diabetes is considered a polygenic disease contributed by the inheritance of multiple predisposing genetic variants. Currently, over 400 genetic variants have been reported to associate with incident type 2 diabetes and diabetes complications in diverse populations. Most of the variants are common with population frequency over 5% but all have small effect sizes. Polygenic risk score is a summation of all the at-risk alleles carried by an individual and represents an aggregate estimate of overall genetic liability for type 2 diabetes or diabetes complications. Ideally, communicating genetic risk of diabetes to people who have not yet developed diabetes could encourage lifestyle change especially in those deemed to be at high genetic risk. Among patients with known diabetes, knowledge of having a high genetic risk of diabetes complications could motivate more aggressive use of pharmacotherapy and improve adherence to diabetes self-care. However, ongoing research is needed to understand whether polygenic risk score add value to predictions using routine clinical parameters. It is also not clear whether genetic information can result in sustained health benefits, or if it could in fact be harmful or cause stress particularly in those who are anxiety-prone. In a randomised controlled trial of 420 Chinese with type 2 diabetes without chronic kidney disease genotyped for genes related to kidney complications, the group who were informed about their genetic risks experienced increased level of diabetes empowerment, positive attitude and reduced diabetes stress.

Conclusion

The Chinese University of Hong Kong – Prince of Wales Hospital Diabetes Care and Research Team has been commissioned by the Health Bureau to undertake a research on precision medicine in Chinese with young-onset diabetes. As part of this research, the team recruited over 800 patients with young-onset diabetes to examine the long-term effect of treatment algorithm guided by biogenetic markers enhanced by JADE technology with informational support, compared to JADE-care alone, for attainment of cardio-metabolic targets and clinical outcomes. The group hope to continue to share their experience with physicians and nurses working with people with diabetes on the use and interpretation of biogenetic tools, to improve characterisation of patients with diabetes for tailored treatment and prognostication.

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Telehealth in OLMH

Dr. Mak Kwan Ping (OLMH, ACON (M&G))



Introduction

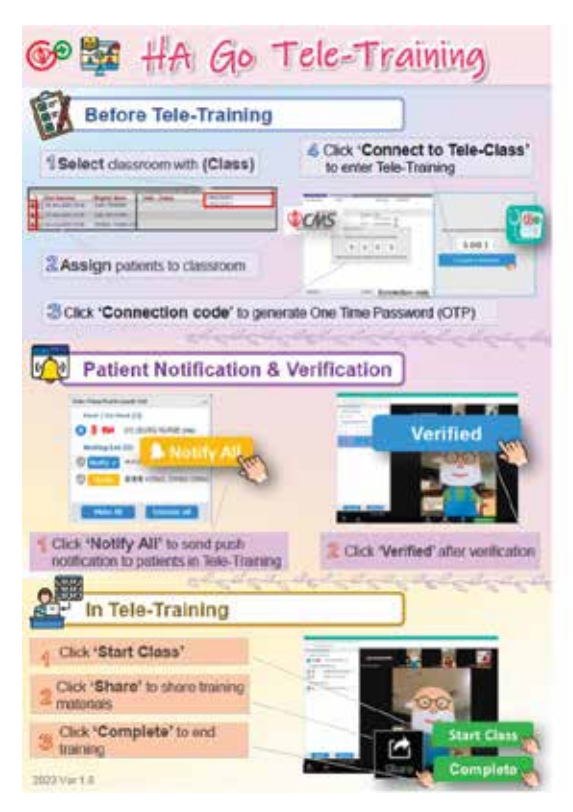
Telemedicine is a rapidly growing field that allows remote medical consultations and the provision of healthcare services using telecommunications technology. It is defined as "the delivery of health-care services where distance is a critical factor, by all health-care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries all in the interests of advancing the health of individuals and their communities" [1] This article aims to provide an overview of telemedicine, its benefits, and shares our experience in launching our teleconsultation service in our DM clinic in Our Lady of Maryknoll Hospital.



Telemedicine Technologies

Telemedicine relies on various technologies to facilitate remote consultations and deliver healthcare services. These technologies include:

1. Video Conferencing: Real-time video communication allows patients and healthcare professionals to interact face-to-face, mimicking an in-person consultation.
2. Mobile Health Applications: Mobile apps enable patients to track their health conditions, receive reminders, and communicate with healthcare providers.
3. Electronic Health Records (EHR): EHR systems store patients' medical information securely, allowing healthcare providers to access and update records remotely.
4. Remote Patient Monitoring: Devices like wearables and sensors collect vital signs and transmit data to healthcare providers for remote monitoring and analysis.



In the Hospital Authority (HA), numbers 1 and 2 are achieved with the new teleconsultation platform in CMS together with the patient's registered HA Go app. Number 3 is what we already have, the ePR platform. What we are lacking is number 4. We do not have a designated platform or device for patient's remote monitoring yet, but this can be compensated by patients' own monitoring at home such as blood pressure monitoring and glucose monitoring. The data can then be shared during tele consultation. Latest continuous glucose monitoring system allows synchronisation of data with healthcare providers through a designated platform, such that the data can be analysed before the actual consultation.

Benefits of Telemedicine

Telemedicine offers numerous benefits to both patients and healthcare providers. Some of the key advantages include:

1. Convenience and Time Savings: Patients can consult with healthcare professionals from the comfort of their homes, eliminating the need for travel and reducing wait times. This is particularly beneficial for individuals with mobility issues, chronic conditions, or those living in remote areas.
2. Cost-Effectiveness: Telemedicine reduces healthcare costs by minimizing transportation expenses and avoiding unnecessary hospital visits.

The rise of telemedicine in Hong Kong

Although telemedicine is a well-established technology in many countries, it is not commonly used in Hong Kong. The COVID-19 pandemic, which created barriers in accessing physical services, catalysed the implementation of telemedicine service.Undoubtedly, the benefits of telemedicine mentioned above perfectly deal with the unprecedented demand of healthcare services. The power of telemedicine was illustrated for the first time to both patients and healthcare providers in Hong Kong.

With the experience from the pandemic, HA swiftly extended the use of telemedicine in various clinics beyond treating COVID-19, including medicine, geriatrics, psychiatric clinics, etc. Endocrinology follow up clinic is one of the

15 highlights of telemedicine developmentas planned by HA. In Our Lady of Maryknoll Hospital, we began the trial run of telemedicine service for patients followed up in our diabetes clinic.

Five groups of patients who might benefit from telemedicine were identified. They included

- Working class
- Young and middle-aged patients
- Housewives
- Pregnant patients
- Patients with poor glycaemic control

The intake criteria for telehealth consultation were followed with reference to HA's guideline [2], which include

- HA Go Full member
- Physically in Hong Kong
- Communicable via electronic means
- Patient or carer capable of managing telecommunication technologies
- Clinically stable DM not requiring immediate hospitalization
- Not requiring physical examination

The clinic was set up with a CMS workstation and an iPad. The CMS workstation is updated to allow access of HA Go telehealth function and also allows nurses or clinic clerks to verify patient's identity. The iPad is the actual platform to conduct teleconsultation, where patient's own smart phone is connected to us.

Patient's telemedicine journey

Eligible patients are recruited from DM clinic during their follow up consultations. They are referred to our telehealth ambassadors to help them install HA Go app on their phones and brief them on how to use the app. The HA Go app will remind patients automatically.

On the day of teleconsultation, patients can register and pay in HA Go app within 2 hours before the appointment. They will be called by clinic clerk to verify their identities.

Doctors will log into the CMS designated teleconsultation module and click on the patient's name, which will generate a unique QR code for the patient. The QR code is scanned with the telehealth app on iPad, which will launch the teleconsultation platform and send a notification to the patient's HA Go app. Once the patient respond to the notification in HA Go app, doctors can enroll the patient through the iPad platform and begin the teleconsultation.

After the consultation, the follow up issues are managed in the same manner as physical consultation with the help of nurses:

- Arrangement of next follow up: Teleconsultation should be episode based rather than case based. Doctors should decide whether the next follow up can be a teleconsultation again or a physical consultation should be arranged.
- Drug collection: Patients can choose to collect the drugs from pharmacy in the usual manner or use the newly developed medication delivery service at a cost of $65 per prescription. This new service provides same day delivery to home or other designated places on the same day of consultation if the drugs are ready before 3pm, otherwise the delivery will be arranged on the next working day. In the HA Go app, patients can pay the prescription fee and the delivery fee and would be shown the estimated time of delivery.
- Investigations reminders: Patients may collect the physical reminder or can view them in HA Go

Challenges in telemedicine and how to overcome them

While telehealth offers numerous benefits, there are also some potential pitfalls to consider. It is important to be aware of these challenges to ensure the effective implementation and utilization of telehealth services.

1. Technical Issues: Telehealth heavily relies on technology, such as stable internet connections and video conferencing platforms. Technical glitches, connectivity issues, or inadequate infrastructure can disrupt the tehealth experience and hinder effective communication between healthcare providers and patients. IT supporting staff is available to deal with technical issues in the clinic. In rare cases, patients need technical support as well and we will contact the patient over phone.
2. Limited Physical Examination: Telehealth may not provide the same level of physical examination as in-person visits. Healthcare providers may have limited ability to perform hands-on assessments, which could impact accurate diagnosis and treatment decisions. Certain conditions may require in-person evaluations for a comprehensive assessment. This requires doctors' clinical judgement to offer timely physical consultation as necessary.
3. Privacy and Security Concerns: Telehealth involves the transmission of sensitive patient information over digital platforms. Ensuring the privacy and security of patient data is crucial to maintain confidentiality. Healthcare providers must implement robust security measures to protect patient information from unauthorized access or breaches. It is therefore important that the consultation is conducted through the designated platform rather than using commercially available applications.
4. Establishing Trust and Communication: Building trust and effective communication between healthcare providers and patients can be more challenging in a remote setting. Non-verbal cues and physical presence may be limited, potentially impacting the patient-provider relationship and the overall quality of care. Therefore, all new patients should be evaluated with physical consultation. Teleconsultation can be offered once rapport has been established.
5. Limitations in medication delivery service: At the moment, prescription with dangerous drugs and self-financed items would be excluded for delivery service. Also, the slight delay in delivery means that if there are drugs that patients should start urgently, such as antibiotics, then the service would be unsuitable. To minimise the chance that patients may run out of stock of medications, we would prescribe extra week of drugs to patients who are joining teleconsultations. This would give them some buffer in case they opt for medication delivery service.

By addressing these pitfalls through proper planning, training, and infrastructure development, healthcare providers can maximize the benefits of telehealth while mitigating potential challenges.

Conclusion

Telemedicine is a game-changer in the healthcare industry, providing improved access, convenience, and cost-effectiveness. By leveraging various technologies, telemedicine enhances patient care, expands specialist availability, and revolutionizes healthcare delivery. As technology continues to advance, the potential for telemedicine to transform the medical landscape is immense.

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A Train-the-Trainer Program to Prevent Insulin-Induced Lipohypertrophy

Ms. Shimen AU (HKECMED NC (Diabetes))

Introduction

The discovery of life-saving insulin therapy a hundred years ago effectively transformed patients with type 1 diabetes from a fatal diagnosis into a medically manageable chronic condition. However, insulin-induced skin lipohypertrophy (LH) is a common but underestimated diagnosis in numerous patients with multiple daily insulin injections.

LH is the major local complication of insulin injection associated with the lipogenic action of insulin at the site of injection and repeated trauma related to performing insulin injections at the same site (Barola, 2018), leading to higher rates of unexplained hypoglycaemia, higher blood glucose variability, worsened glycaemic control, higher insulin dose consumption leading to increased healthcare costs. LH is preventable through proper insulin injection technique, systematic injection site rotation and examination.

Objectives

To design a training programme for nurses on detection and prevention of LH based on best available evidence; to align the manual examination skills and documentation method among Diabetes Centres in Hong Kong.

Method

A workgroup of five diabetes nurses was formed in 2021 to perform literature search on the global and local prevalence rate of LH, the risk factors and consequences of LH, the proper insulin injection techniques to avoid LH and the method to document LH. The evidence, recommendations and training package on detection and prevention LH would be shared to all members of the Association of Hong Kong Diabetes Nurses.

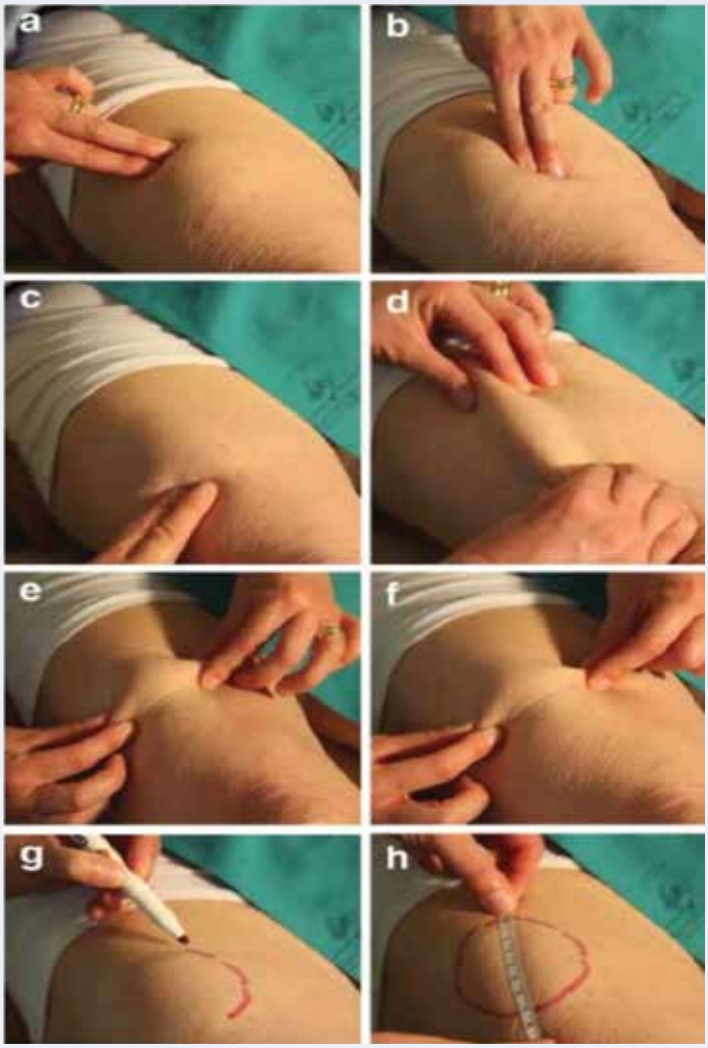
Development of the Training Package

1. Literature on Prevalence Rate of Lipohypertrophy

The prevalence of insulin-induced lipohypertrophy (LH) varies widely depending on the population studied and the methods used to assess LH. A meta-analysis of 26,865 participants from forty-five studies showed that the overall prevalence of LH was 41.8% (95% CI: 35.9% to 47.6%) when LH was diagnosed by observation and palpation. On region-wise analysis, the pooled prevalence of LH in Asia was 41.3% (95% CI: 27.2% to 55.3%) and in studies only on type 1 and type 2 DM patients was 39.9% (95% CI: 28.3% to 51.6%) and 45.9% (95% CI: 29.5% to 62.4%) respectively. Only insulin duration was found to significantly influence the prevalence of LH on meta-regression (Wang K, 2021).

In a prospective cohort study in China with a total of 162 patients with diabetes who used insulin therapy more than 1year, Ultrasound examination detected 41.1% more patients (74.1% vs 52.5%; P < .001) with lipohypertrophy than physical examination by a team of diabetes educator nurses or ultrasonographer in a blinded fashion (Wang W, 2021)

In Hong Kong; we reviewed the record of 23,786 insulin-users who had LH assessed by Diabetes Nurses during Complications Screening in 2020/21, the prevalence of LH was estimated 13.4 - 25.6% in public hospitals and clinics.



2. Risk Factors of Lipohypertrophy

Exert pressure close to the lesion

Examine under tangential light

Identified risk factors for LHs include needle reuse, failure to rotate injection sites, and ice-cold insulin injections(Gentile, 2020). A multivariate analysis from Thailand revealed that the duration of insulin use (≥10 years), use of human insulin, and incorrect rotation of injection sites were associated with LH. Patients with LH were found to have 7-times greater risk of unexplained hypoglycemia when compared with patients without LH (Thewjitcharoen, 2020). Injections into lipohypertrophic tissue can change insulin absorption and action with consequent sudden blood glucose elevations and variability. All these consequences have an economic impact on the health system (Gentile, 2022).

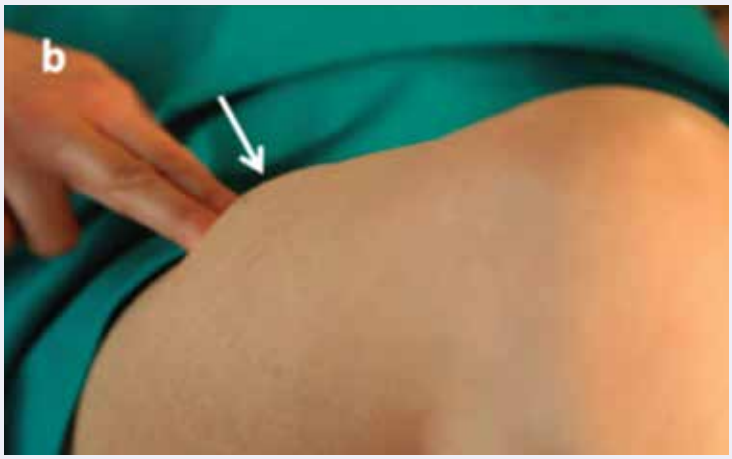
Subclinical Lipohypertrophy

Type 1 diabetes, increasing BMI, incorrect rotation of sites and insulin needle reusage for more than four times have been identified as the risk factors for subclinical lipohypertrophy(Luo, 2021).

3. Lipohypertrophy Identification Training Protocol

The training is based on the protocol proposed by the Italian Injection Technique Study Group which has been proven by study that after a specific training, healthcare professionals can identify Lipohypertrophy lesions at a high diagnostic accuracy of 97% consistent with the Skin Ultrasound Scans (Gentile, 2016)





Palpation technique

-Examine under tangential light (Figure a) & exert pressure close to the lesion (Gentile, 2016) (Figure b).

-Use lubricant (Gentile, 2020)

-Slow circular & vertical finger-tip movements; be gentle at the beginning & increase finger pressure gradually; perform the pinch maneuver (Diagram d-f) when recognizing a harder skin (Gentile, 2016)

-Mark the exact position of the lipohypertrophy with marker pen (Diagram g & h) (Gentile, 2016)

A structured educational package including the presentation slides, education leaflet on proper insulin injection technique, injection assessment form, injection rotation grid, patient pamphlet on LH, video demonstration on LH assessment and its procedure checklist, LH documentation form, mnemonic for prevention of LH, pre- and post-training quiz and the evaluation form was designed.

The Train-the-Trainer Programme on Detection of lipohypertrophy

Two identical education seminars and one train-the-trainer workshop were conducted on 26 November 2022 and 7 Jan 2023. Ninety nurses attended the seminars; of which forty-six of them completed the workshop to be the trainer. Participants were reminded to follow the Evidence–based Clinical Guideline on Subcutaneous Insulin Injection.

AHKDN Guideline on How should lipohypertrophy be managed?

1. Injection into the hypertrophic areas should be avoided.
2. Training of health care professionals is required to identify Lipohypertrophic lesions.
3. Visual inspection and palpation of injection sites by health care professionals should be performed routinely and documented.
4. Intensive patient training on injection technique, systematic rotation and frequent inspection is effective in improving and in preventing lipohypertropy.
5. A decrease in insulin dose may be required when switching insulin injection from areas of lipohypertrophy to normal tissue and should be guided by blood glucose measurements. (AHKDN 2021)

Conclusion

Systematic inspection of lipohypertrophy regularly by nurse is as important as systematic rotation of insulin injection sites by patients. It is of utmost importance that nurses can teach and verify patient performing accurate skin inspection and self-palpation before insulin injection.

While high-tech in healthcare is advancing, high-touch in nursing is still rewarding.

"Lipohypertrophy, a condition we fear;
From insulin injection, it can appear,
But prevention is possible, let me make it clear;
With proper technique, there's nothing to fear."

~By ChatGPT

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Case study on CAPD patient with Ambulatory glucose profile (AGP)

Ms. SIN WAI MAN (UCHN ANC (DM))



Background of the patient

Mr Liu was a 70 years old retired gentleman living with his daughter. His activity of daily living was independent and he was mostly alone during daytime. He had a history of Type 2 diabetic mellitus(DM)since 1982 and has started insulin since February 2004. Besides, he had end stage renal failure due to DM nephropathy with tenckhoff insertion in January 2022. He received continuous ambulatory peritoneal dialysis (CAPD) by himself with occasional support by his youngest daughter. He was on a three-bag PD regimen of 1.5% dextrose, with exchanges at 0700, 1500, and 2300. He also had hyperlipidemia.

He usually woke up at 0700 and took his breakfast at 0700 with a mini piggy bun or 1 slice of bread. He took lunch at 1300 with 1 bowl of rice with meat and veggie. For dinner at 1900, he had 4/5-1 bowl of rice with egg, meat or veggie. He seldom ate fruit and usually slept at 0100.

His anti-DM medications included Mixtard 30HM 26units before breakfast and 12units before dinner. His body weight was 74.3 kg and he was 1.73m tall, with BMI being 24.83. His blood pressure was stable being 141/82 mmHg. His HbA1c results ranged from 7- 7.8% in August 2020 to November 2021 with fasting glucose of 4.8 mmol/ in February 2022. In the same month, his lipid profile was fairly good with total cholesterol of 2.84 mmol/L, LDL-C of 1.24 mmol/L, HDL-C of 1.13 mmol/L and TG of 1.03 mmol/L. Blood test in April 2022 showed high serum creatinine of 680 umol/L, with estimated GFR of 6 ml/min/1.73 sq. m (by CKD-EPI formula) and haemoglobin: 13.9 g/dL.

Self-monitoring blood glucose (SMBG) readings and problems identified

The patient had been put on Mixtard for many years with stable glycaemic control before starting CAPD with HbA1c ranging from 7-7.8% in August 2020 to November 2021. In early April 2022, he was referred for DM management from the renal clinic because of high h'stix profile with hypoglycemia before lunch. While on 1.5% peritoneal fluid, the h'stix profile from 1/4 to 25/4/2022 was shown as below :

fasting ~ 16.5/ 8.8/ 8.4/ 7.9/ 12 mmol/L pre lunch ~ 6.5/ ↓ 3.6/ 4.1 mmol/L

pre dinner ~ 15/ 9.4/ 17.6/ 10.1 mmol/L bedtime ~ 20.9/ 17.4/ 11.4 mmol/L

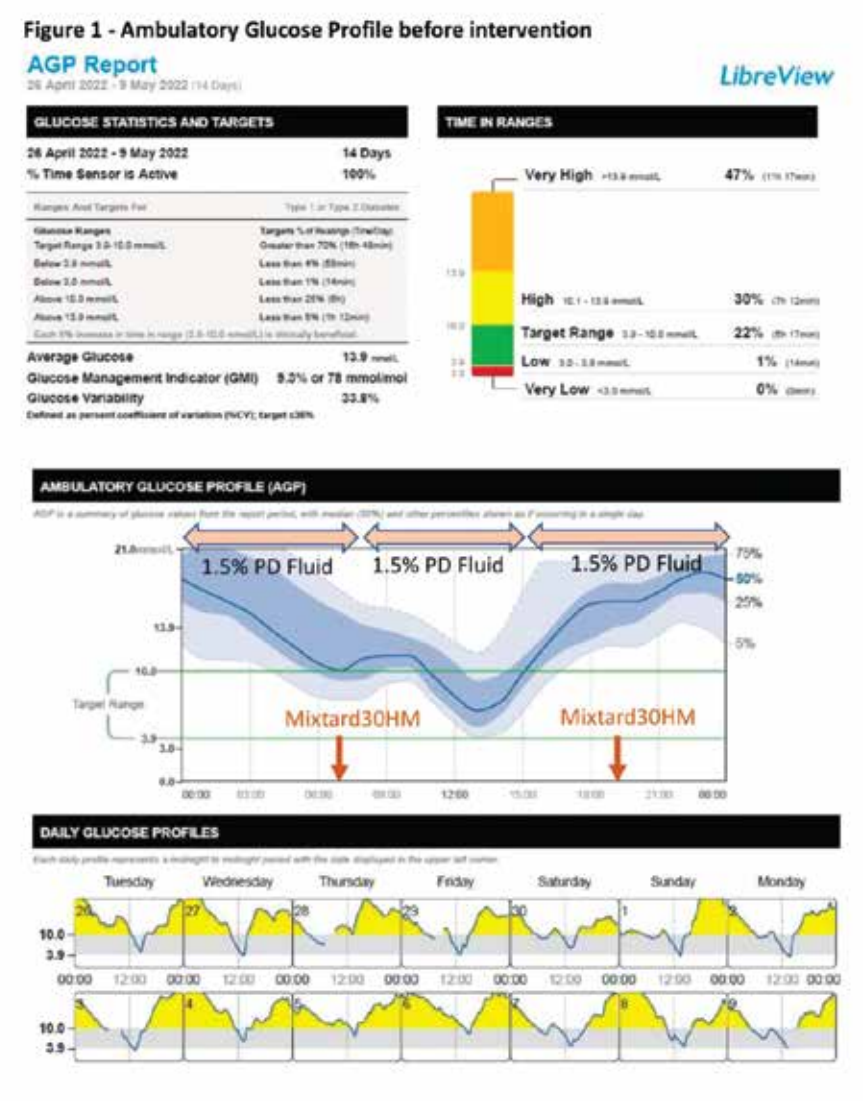
At the first visit, patient's injection and h'stix technique was assessed and no problem was identified. There was no abnormality noted at insulin injection site. His diet was reviewed with acceptable CHO portions for lunch and dinner but inadequate CHO portions for breakfast due to low appetite in the morning. He felt frustrated of wide fluctuation in h'stix profile after starting CAPD. Besides, he refused to do finger pricking more frequently as he became a bit scared of finger pricking. After explaining the benefit of using CGMS-AGP, patient was put on AGP monitoring.

AGP report: (Figure 1)

AGP report revealed low glucose trend from mid-night and high risk of hypoglycaemia before lunch.

After reviewing the AGP report, he was advised to resolve the problems identified.

Figure 1 - Ambulatory Glucose Profile before intervention



1) Avoidance of hypoglycemia

Patient complained of hypoglycemic symptoms before lunch but he still had high glucose after lunch since insulin was stepped up. He felt very frustrated because he had modified his diet already since he noticed his persistent high h' stix, yet the glucose level was still not well controlled. The action profile of Mixtard was explained to him. He was suggested to have a bigger meal portion at breakfast and cut down CHO portion at lunch. However, he refused because of low appetite in the morning. Therefore, I suggested he step down om insulin 2 units first to prevent hypogylcaemia.

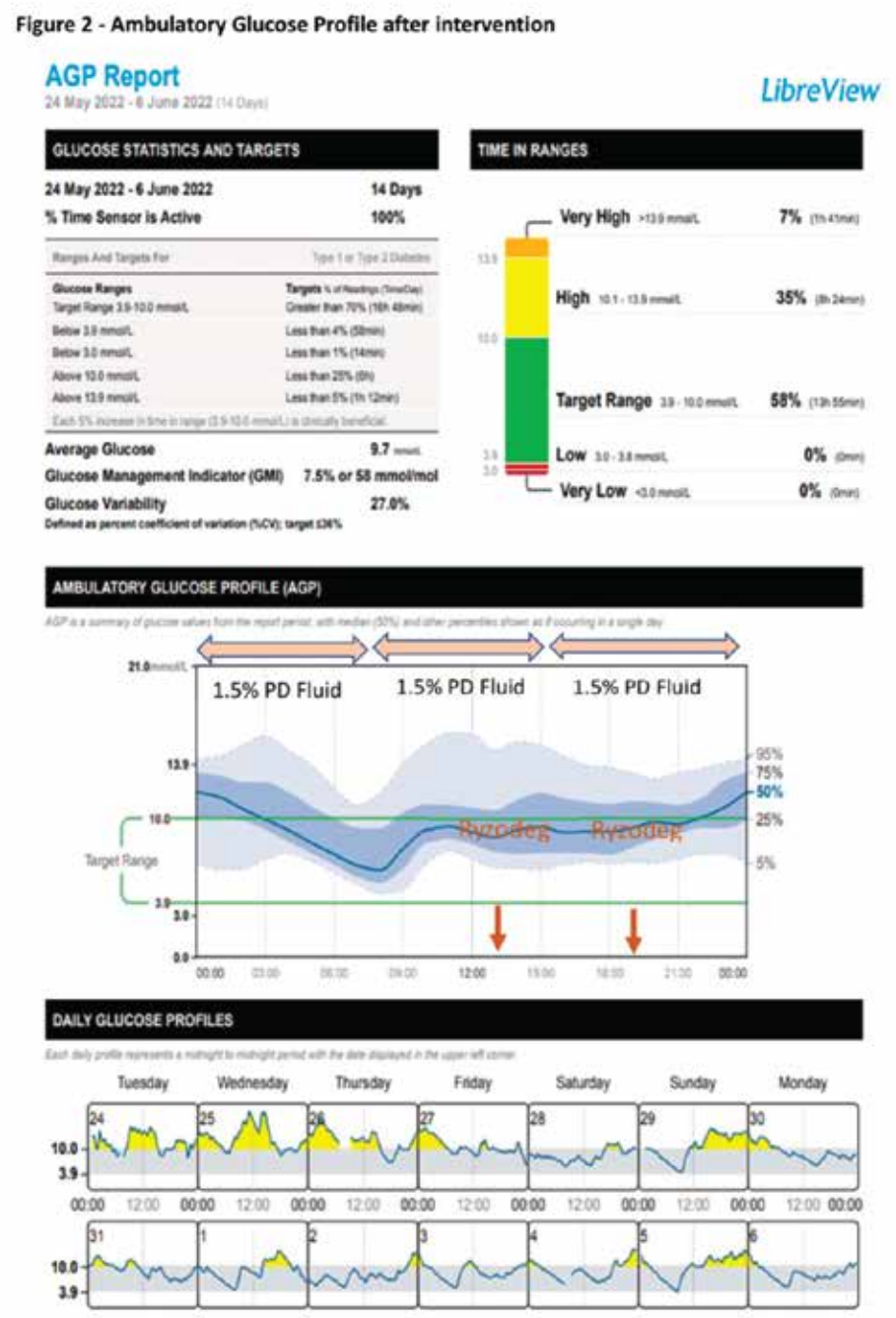
2) Reduction of hyperglycemia

I explained the action profile of Mixtard that it could not control high glucose before dinner. Therefore, he was primed to be switched to tds Novomix which could cover post-prandial surge, especially at post-lunch and post-dinner periods. Nevertheless, the patient strongly refused to have 3 shots of insulin injection. In view of the very high glucose after dinner, I suggested he should step up 2 units of pm dose Mixtard and keep SMBG and AGP.

Changing insulin regimen after 1st AGP

The current insulin regime was not matching his lifestyle. After discussion with the endocrinolologist, the patient was advised to replace Mixtard by Ryzodeg before lunch and dinner since he refused 3 shots of insulin injection. I explained the action profile of Ryzodeg (70% of degludec + 30% aspart) to him and educated the new injection time, reminded him to keep adequate CHO portions, for example, 4/5 bowl of rice for lunch and dinner. I also recommended him to put on a 2nd AGP to review the glucose profile.

Figure 2 - Ambulatory Glucose Profile after intervention



After 2nd AGP installation

With the new regimen, the AGP report showed no more hypoglycaemia at pre-lunch and more stable glucose profile after lunch and dinner (Figure 2). The TIR (time in range, 3.9-10mmol/L) improved from 22% to 58%, and the very high range improved from 47% to 7%.

Patient felt satisfied with the AGP profile after switching to Ryzodeg as there was less fluctuation in glucose profile. Subsequently, he had modified his breakfast and did some exercise post breakfast, because he noticed that there was postprandial surge at post breakfast on the first 2 days after AGP installation.

Patient felt very useful in using AGP as he could know more about his glucose profile, for example, how diet and exercise affect his glucose and therefore he was willing to modify his lifestyle according to the glucose pattern. Besides, he was glad that he did not need to check his h'stix frequently and he was eager to buy AGP sensor for monitoring.

After 3rd AGP installation

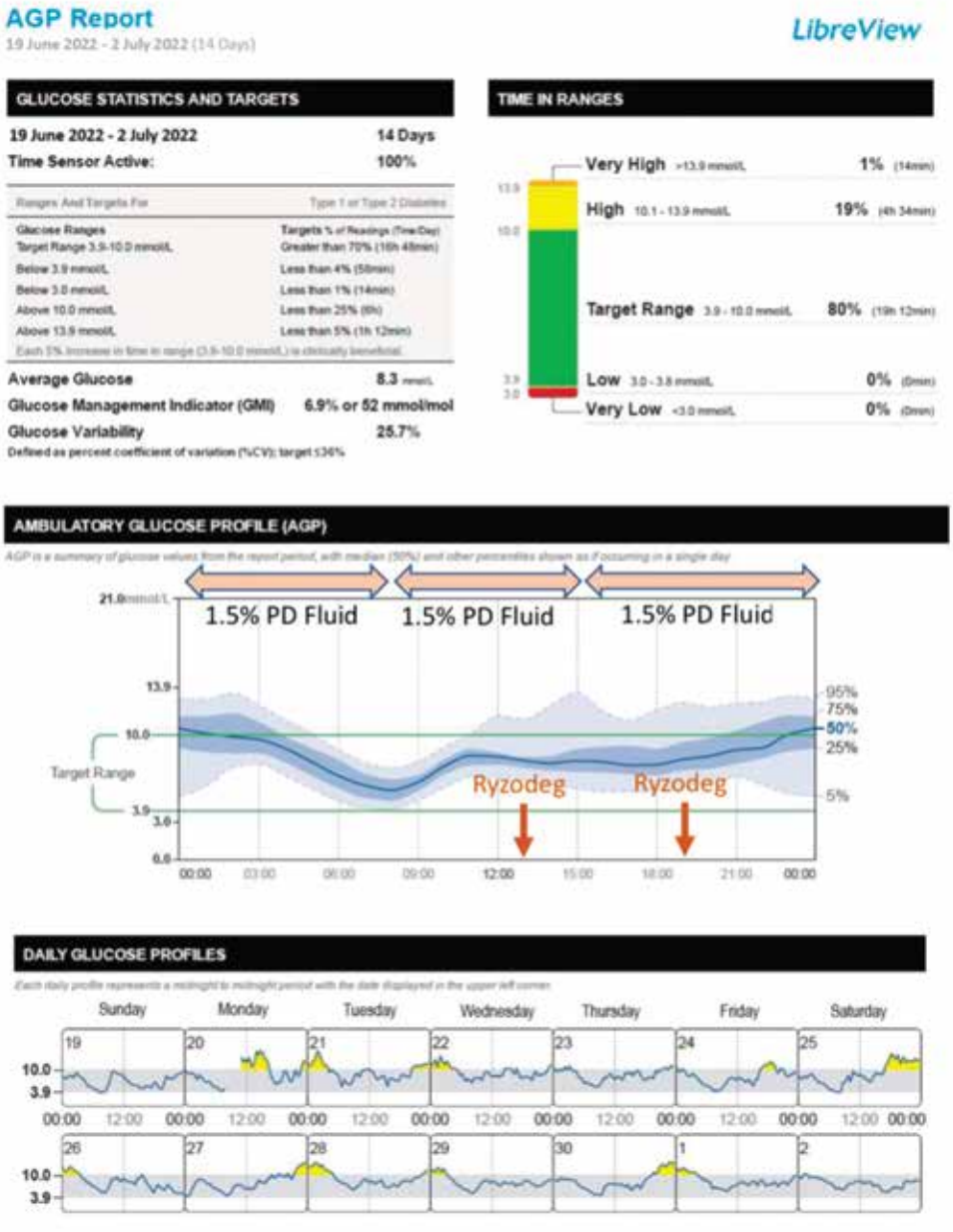
Patient was put on the 3rd AGP monitoring again after one month. The AGP report shown very stable glucose profile all day (Figure 3). The TIR (time in range, 3.9- 10mmol/L) improved from 58% to 80%, and very high range improved from 7% to 1%. He had two episodes of low sensor glucose (3+ mmol/L) at around 8am. Nevertheless, after checking with h' stix, it was confirmed that there was no hypoglycemia.

The patient was very satisfied with the AGP report which reflected his effort in lifestyle modification, for example regular exercise after meals and keeping consistent CHO intake at each meal.

Use of continuous glucose monitoring (CGM) in CKD patient

Monitoring glucose level among patients with peritoneal dialysis is particularly important because they may experience glycaemic excursions with influx of glucose from dialysate solutions (1). Besides, monitoring of glycaemic status in diabetic patients with renal disease is challenging since conventional

Figure 3 - Ambulatory Glucose Profile after intervention



markers such as HbA1c, fructosamine or glycated albumin may be less reliable in patients with advanced renal diseases (1). Continuous glucose monitoring (CGM) which measures the interstitial glucose, either in real-time or intermittent (flash) format have potential roles to overcome these challenges and is now gaining popularity. CGM system can help optimize treatment by providing comprehensive profile for assessment of relationships between glycemic variation, time of dialysis regimens and insulin administration, with standardized AGP in a graphical representation of 24-hour sensor glucose trends. This can also help detecting asymptomatic hypoglycaemia which may be missed by self-monitoring of blood glucose.

Yet, the use of CGM among patients with peritoneal dialysis is controversial. It has been criticized that the of sensor readings may be potentially interfered by endogenous (such as hypoxia or uremia) or exogenous substances (such as paracetamol and ethanol). Moreover, the accuracy of CGM is lower in the hypoglycaemic range and under rapid changes in blood glucose values (2-4). False hypoglycaemic alerts may occur under these considerations, leading to unnecessary treatment. Nevertheless, CGM has been shown to correlate well with self-monitoring of blood glucose measurement, HbA1c, and fructosamine (5,6). Data from small studies, and clinical experience suggest this technology can be beneficial in patient with diabetes with peritoneal dialysis to minimize glycaemic variability and hypoglycaemia (7,8). Further research is required to provide concrete evidence on how well “time in range” (defined as the time spent between glucose levels 3.9 to 10 mmol/l), and glycaemic variability correlate with the clinical outcomes of diabetes-related complications, morbidity and mortality.

Lesson learnt

In this case, the use of AGP to monitor glucose level was considered as very useful since it could provide

overall glucose patterns that facilitated the identification of glucose variability, hyperglycaemia as well as hypoglycaemia episodes. Medical professionals could review AGP reports to give diet advice and insulin regimen adjustment. Besides, patient could prevent hypoglycemia through using the 'Trend arrows' function. Lastly, it was crucial to remind the patients to double check the glucose level with h'stix when low sensor glucose was detected.

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Upcoming Professional Meetings

Course / Conference	Date / Duration	Organizer
Endocrinology, Diabetes & Metabolism Hong Kong (EDMHK) Nursing Workshop 2024	16th and 23rd March 2024	Department of Medicine, School of Clinical Medicine, HKU
Diabetes Preventing the Preventable (DPP) Forum 2024	5th May 2024	Asia Diabetes Foundation, CUHK
THE 16th AHKDN Annual Symposium & Annual General Meeting	22nd June 2024	AHKDN
26th Diabetes and Cardiovascular Risk Factors - East Meets West Symposium	pending	The Hong Kong Institute of Diabetes and Obesity, CUHK