Establishing the multidisciplinary Imperial Physical Activity and Diabetes clinic

Neil E Hill1,2
MRCP, PhD, Consultant in Diabetes & Endocrinology

Sian Rilstone1,2
BSc, MSc, RD, Dietitian

Carol Jairam1
BSc (Hons), MSc, Diabetes Specialist Nurse

Stephen Chew1
MRCP, Consultant in Sports & Exercise Medicine

Dimitri Amiras1
FRCR, Consultant Radiologist

Nick S Oliver1,2
FRCP, Consultant in Diabetes & Endocrinology

1Imperial College Healthcare NHS Trust, London, UK
2Imperial College London, London, UK

Correspondence to:
Neil E Hill, MRCP, PhD, Consultant in Diabetes & Endocrinology, Department of Endocrinology & Diabetes, Charing Cross Hospital, Fulham Palace Road, London W6 8RF, UK; email: neil.hill@nhs.net

Received: 3 December 2017
Accepted in current form: 9 January 2018

Abstract
Increasing numbers of people with diabetes are adopting exercise programmes. Fear of hypoglycaemia, and hypoglycaemia itself, are major issues for many people with diabetes undertaking physical activity. The risk of hypoglycaemia is exacerbated by endurance exercise. In addition, soft tissue injuries are more common in people with diabetes. We have established a multidisciplinary physical activity and diabetes clinic with the aim of empowering, educating and enabling people with diabetes to enjoy sport and exercise without fear of hypoglycaemia or frustration at glycaemic variability or soft tissue injuries. The multidisciplinary team (MDT) includes a diabetologist, sports and exercise physician, radiologist, dietitian, diabetes specialist nurse, and psychologist.

Between October 2015 and September 2017, we undertook 19 clinics and saw 66 patients (48 new and 18 follow-up). Of the 48 new referrals (median age 35; range 20–72) 47 had type 1 diabetes and 27 (56%) used an insulin pump. Attendees had a median 18 years of diabetes (range 1–50). Diabetes distress was variable (median PAID score 18; range 0–64). Twenty-five patients attended for glycaemic management, 15 for musculoskeletal issues and eight for both. Sixteen (33%) required physiotherapy and nine (19%) were referred for joint imaging.

It is possible to establish a new service to support physical activity in diabetes. To meet demand and enhance the MDT, physiotherapy will be added. A means of assessing the effects of diabetes on physical activity and outcome measures that matter to people with diabetes must be developed. Copyright © 2018 John Wiley & Sons.

Practical Diabetes 2018; 35(1): 11–15

Key words
diabetes; multidisciplinary team clinic; physical activity; sport; exercise

Introduction
Increasing numbers of people with diabetes are adopting exercise programmes.1 Evidence for the benefits of regular physical activity in many conditions including diabetes is well known, and has been found to be related to reduction in all-cause mortality, improved cardiorespiratory and metabolic health, and reduction in risk of certain cancers.2,3 People who are moderately active are at a 35–50% lower risk of developing type 2 diabetes than those who are sedentary.1 Even where fitness is not changed by regular physical activity, improvements in metabolic parameters and insulin sensitivity can be seen.3,4 Indeed, it is recognised that low mood and depression are more common in diabetes, and exercise has been shown to improve mood and subjective well-being.5,6 Less studied but equally important are the non-tangible benefits from taking part in physical activity and sports – satisfaction, camaraderie and friendship.

Challenges arise for people with diabetes during physical activity in matching insulin delivery with insulin requirements to enable provision of metabolic substrate to exercising muscles.5 People with diabetes and those trying to support them are often reliant on anecdotal or trial-and-error methods of management, although expert consensus advice has recently been published.9 Fear of hypoglycaemia and hypoglycaemia itself are major issues for many people undertaking physical activity who take insulin or oral agents that stimulate beta-cell activity.10 The risk of hypoglycaemia is exacerbated by endurance exercise because levels of exogenously administered insulin do not fall on commencement of exercise, as occurs in a person without diabetes.11 As glucagon levels are unchanged there is an altered hepatic glucagon to insulin ratio. This results in increased exposure to insulin which can reduce hepatic glucose production so that the
glucose demands of exercising muscle are not met and the risk of hypoglycaemia increases greatly. Contrasting, short bouts of intense ‘anaerobic’ exercise in people with type 1 diabetes can result in hyperglycaemia. The usual insulin rise seen in post-anaerobic exercise does not occur in those with diabetes, with resultant hyperglycaemia.

We have previously shown that in a real-time endurance multi-day cycling event, large reductions in insulin dose were required to prevent hypoglycaemia and the associated decrease in exercise performance. Of particular interest was the psychosocial response to the ride. Words used to describe periods of hypoglycaemia which had affected the riders’ performance were: ‘frustrated’, ‘angry’, ‘grumpy’, ‘upset’ and ‘emotional’, reflecting the negative feelings attributed to hypoglycaemia.

In addition to glycaemia-related concerns, people with diabetes are more likely to suffer soft-tissue injuries associated with physical activity. Adhesive capsulitis of the shoulder is five-times more common in people with diabetes; although the aetiology remains unclear, it appears to be caused by a combination of increased pro-inflammatory mediators and changes in the microstructural organisation of collagen fibres. With people becoming increasingly active, they are more likely to sustain musculoskeletal injuries: a barrier to their ongoing participation in regular exercise.

We previously conducted an audit of consecutive, non-selected patients with diabetes in a specialist clinic. Fifty-five patients completed the audit proforma, totalling 788 years of diabetes experience (median 13 years’ duration).

Of these, the majority (45 out of 55) had type 1 diabetes and 50 took insulin. Thirty-eight people (70%) undertook regular exercise. Of those who did regular exercise, examples of suggestions in response to the question ‘Is there anything we (in the diabetes clinic) could do to help?’ reveal that many people with diabetes have unmet needs and educational requirements surrounding exercise and physical activity. (See Box 1.)

- ‘More 1:1 nutritional advice (still finding carb counting challenging at times); just more help/advice. I am doing everything I can but still finding worrying results’
- ‘Help with exercise suggestions, food types/intake times, regulating insulin for my type of exercise & intensity; maybe do exercise assessment to see the real-time impact of exercise on my blood sugar level’
- ‘Keep me informed and up-to-date with any medical advances and innovations relating to my condition’
- ‘Perhaps forming a gym class once a week’
- ‘Provide more material up-front; had to do most research on my own’
- ‘Signpost to help’
- ‘Recommend suitable footwear and care for patients – maybe help aid with suitable insoles’
- ‘Explain how I can better monitor my blood glucose or predict how my blood glucose will change while I do my exercise. What can I expect? What is the physiology behind it? Adrenaline, glucagon, glycogen – explain how these hormones affect my blood glucose’

Box 1. Selected responses to the question ‘Is there anything we (in the diabetes clinic) could do to help?’ in an audit of 55 people with diabetes attending a specialised clinic

Currently, there is a wide range of exciting and innovative research into diabetes and exercise, incorporating novel strategies, such as the use of caffeine supplements through to tailored physical activity programmes. To the best of our knowledge, however, there are no specialised multidisciplinary teams (MDTs) providing holistic care to cater for the needs of people with diabetes who wish to undertake any form of physical activity.

We established the Imperial Physical Activity and Diabetes (IPAD) clinic in 2015 and present our initial results. A multiprofessional approach was adopted to assess specific barriers to the individual and the desired physical activity programme in order to devise strategies to address: nutritional intake; glucose monitoring in different modalities; insulin adjustments; and education to support decision making. Our goals are to develop confidence in managing blood glucose before, during and after exercise, diagnose and treat injuries, improve mood, and reduce fear of hypoglycaemia, in order to facilitate continuation of physical activity in this patient population.

Methods

The multidisciplinary IPAD clinic runs for one afternoon each month, seeing up to six patients. Patients are referred from existing clinics within Imperial College Healthcare NHS Trust or by their general practitioner (GP). Each clinic is preceded by a meeting of the MDT members to discuss the new patients and consider what interventions may be beneficial. Our goals are to: reduce activity-associated hypoglycaemia; improve metabolic parameters (if possible); overcome barriers to exercise (such as fear of hypoglycaemia); and positively impact on diabetes-related distress through empowering enhanced self-management of diabetes before, during and after physical activity.

The following health care professionals take part in the physical activity clinic:
- Diabetes consultant: explain and advise on management of blood glucose, prevention of hypoglycaemia; insulin and medications; interpretation of continuous glucose monitoring (CGM); clinic lead.
- Sports & exercise medicine consultant: management and prevention of injuries; exercise prescription.
- Diabetes specialist nurse: supporting insulin and injectable therapy use; self-monitoring, management of CGM devices.
- Diabetes dietitian: 1:1 nutritional advice, management of carbohydrate and insulin around exercise; advice on weight control strategies.
- Radiology consultant: diagnosis and management of soft tissue injuries.
- Psychologists: managing barriers to physical activity.

We aim to contact our patients by telephone or email prior to their initial appointment to ensure a convenient clinic time and date, and explain the aims and processes.
Care delivery

Establishing the multidisciplinary Imperial Physical Activity and Diabetes clinic

Table 1. Presenting complaints and clinical diagnoses for initial appointments of people attending the IPAD clinic with musculoskeletal issues

<table>
<thead>
<tr>
<th>Anatomical region</th>
<th>Presumed diagnosis</th>
<th>No. of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder</td>
<td>Adhesive capsulitis</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Subacromial bursitis</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Shoulder impingement</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>AC joint sprain after rugby</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rotator cuff tear</td>
<td>1</td>
</tr>
<tr>
<td>Lower back</td>
<td>Lower back pain</td>
<td>1</td>
</tr>
<tr>
<td>Hip</td>
<td>Gluteus tendinopathy</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Femoracetabular impingement or labral tear</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Gracilis and rectus femoris eccentric overload</td>
<td>1</td>
</tr>
<tr>
<td>Knee and lower limb</td>
<td>Medial tibial stress syndrome</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Call tightness</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Knee pain</td>
<td>1</td>
</tr>
<tr>
<td>Foot</td>
<td>Peroneal tendinopathy</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Plantar fascitis</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Achilles tendinopathy and retrocalcaneal bursitis</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pins and needles</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Foot pain</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1. Presenting complaints and clinical diagnoses for initial appointments of people attending the IPAD clinic with musculoskeletal issues

involved in the IPAD clinic. During the initial clinic appointment all patients have demographic data recorded. Their insulin usage, other medications, duration of diabetes, complications of diabetes, and physical activity history data are collected. In addition, their ambitions and barriers to exercise are explored in a semi-structured interview. Injuries are documented, investigated and, if possible, treated. Following consultation with the consultant in sports & exercise medicine, referral to physiotherapy may be made for ongoing management of soft-tissue injuries or for imaging as required. Issues pertaining to glycaemic control and management are reviewed by our diabetologist, dietitian and diabetes specialist nurse. Triggers to psychological referral include: depression, anxiety, fear of hypoglycaemia, and adaptation issues with diabetes. Online and specialist peer-support groups with an interest in diabetes and physical activity are signposted if appropriate. Questionnaires on diabetes-related distress (Problem Areas in Diabetes [PAID] survey18), hypoglycaemia awareness (Gold score) and recent physical activity (Recent Physical Activity Questionnaire17 [RPAQ]) are completed. Patients may be requested to complete exercise/food/glycaemia diaries. Participants receive a clinic letter emailed to them following each clinic visit. The letter details issues discussed during the appointment and a detailed multidisciplinary care plan.

Results

Between October 2015 and September 2017, we undertook 19 clinics and saw 66 patients (48 were new and 18 follow up). Of the 48 new referrals 47 had type 1 diabetes (median age 35; range 20–72) and 27 (56%) used an insulin pump. Of the new referrals, 27 were males and 21 females, with a median 18 years of diabetes (range 1–50). Hypoglycaemia awareness was intact (Gold score <4) in 37 people and impaired in seven (no data for four people). Diabetes distress was variable (median PAID score 18; IQR 7–34; range 0–64; n=45). Twenty-five patients attended for glycaemia management and 15 for musculoskeletal issues and eight for both. Of those referred for help with glycaemia management, nutritional advice and insulin dose adjustment were recommended according to the specific issues encountered. Diagnostic CGM was offered to seven of the newly-referred patients. Sixteen people (33%) required physiotherapy and nine (19%) were referred for soft tissue imaging (five of these were for possible intervention for shoulder problems: intra-articular or sub-acromial steroid injection or hydro-dilatation). We have provided advice and support to patients undertaking a range of activities including the London to Paris cycle ride, and trekking and climbing in the Himalayas.18 The predominant activity undertaken by our patients has been running, but includes cycling, swimming, football, gym (weights, classes, high-intensity training, Crossfit, spinning), boxing, rugby, tennis, golf, squash, badminton, and hill walking. No-one has yet been directly referred for psychological support; however, a few of our patients have utilised this service through other clinics.

The 18 follow-up appointments included two people followed up on two occasions. Of the 16 people having a first follow-up appointment, eight were for glycaemia management, six musculoskeletal issues and two for both. Diagnostic CGM was requested for one person and imaging for five people. The musculoskeletal diagnoses predominantly affected the large joints – shoulder, hip, and knee, and are listed in Table 1.

For those with PAID data at initial and first follow-up appointments, five had improved and five were worse (Figure 1); however, the magnitude of the changes was not statistically significant (p=0.43).

Discussion

At Imperial College Healthcare NHS Trust, we have established a multidisciplinary physical activity
Establishing the multidisciplinary Imperial Physical Activity and Diabetes clinic

Care delivery

and diabetes clinic to empower, educate and enable people with diabetes to manage their blood glucose when they undertake physical activity. We utilise the skills and expertise of a consultant diabetologist, a consultant in sports & exercise medicine, a diabetes specialist nurse with expertise in diabetes technology, and a diabetes dietitian with an interest in running. We have access to diagnostic and therapeutic radiology and psychology services. We aim to provide a comprehensive approach to diabetes management and provide enhanced self-management care in the context of carefully-planned physical activity recommendations.

Setting up a multidisciplinary clinic like this is not without challenges. We are fortunate that our job plans have the flexibility to allow us to run the clinic regularly and for the support of our colleagues. Our future challenges are to secure funding for all clinic staff (at present one is paid for by the Ministry of Defence, one is in research and one does the clinic without direct remuneration). We do not have administrative support, so contact with patients to book clinic timeslots and change appointment times is done by the clinical staff.

Our outcome measures are rudimentary and, although this clinic has demonstrated potential, proving the efficacy and value of the clinic is difficult. We do not have direct access to physiotherapy at present, necessitating patients to return to their GPs for this which we feel is cumbersome and inefficient. We have limited access to CGM for this clinic.

Although exercise is important to many people (with and without diabetes), determining the effectiveness of an intervention to assist diabetes management in those undertaking physical activity is difficult and may not be reflected in outcome parameters that are routinely measured in clinic or in diabetes trials, for example:
- HbA1c may not reflect the improved empowerment or being able to exercise (relatively) free from fear of hypoglycaemia.
- Change in body mass or body composition may not be the primary objective of exercise.
- Frequency of hypoglycaemia can be difficult to record and may not reflect time spent in hypoglycaemic range.

While it is possible to measure glucose excursions by utilising continuous glucose monitoring, CGM is not always widely available and cannot assess the stress, frustration and uncertainty that exercising in the presence of exogenous insulin can entail. The change in PAID scores between initial and follow-up IPAD clinic appointments does not suggest overwhelming success; however, it is important to highlight that the sample size was small (n=10) and that PAID is a generic assessment reflecting distress in all areas of life and is not specific to physical activity. Further extrapolation of these limited results seems unwarranted. Although a validated questionnaire looking at barriers to physical activity exists, it looks at reasons why some people with diabetes do not exercise; it does not capture the difficulties encountered by people with diabetes who are currently exercising and are suffering with injuries or have become frustrated by glycaemic variability. Therefore, a comprehensive assessment that is both reflective of, and responsive to, the factors that are important to people with diabetes undertaking physical activity is required.

In the future, we intend to undertake systematic work to show the clinical and cost effectiveness of the clinic. We hope, with time and adequate infrastructure, that patients could self-refer themselves to the clinic. This would remove the need for them to be seen and assessed by GPs for issues that even we, who deal with these conditions daily, often find challenging. The future model of clinic that we hope to provide could encompass:
- Self-referral via an online booking system.
- Completion of diabetes and physical activity questionnaires, as well as patients’ goals and expectations prior to clinic.
- A one-stop-shop which enables assessment by the core clinic team, with on-the-day access to physiotherapy and radiology services.
- Follow-up questionnaires and a clinic letter to be electronically sent to patients detailing the agreed management strategy.

If we can secure appropriate funding or support, we will invest in diabetes technology that will help us to address issues relating to glycaemic variability and hypoglycaemia associated with physical activity. If patient numbers increase, we will aim to increase the frequency of the IPAD clinic to twice monthly.

In summary, physical activity is important for cardiovascular risk reduction in individuals with diabetes. It is associated with improved...
quality of life and decreases in distress levels in a number of populations. We have established a new multidisciplinary physical activity and diabetes clinic aiming to: develop confidence in managing blood glucose before, during and after exercise; improve mood and reduce fear of hypoglycaemia; and minimise or address barriers to physical activity in this subset of patients.

The Imperial Physical Activity and Diabetes clinic can be contacted at: imperial.physical.activity.diabetes@nhs.net.

Declaration of interests
There are no conflicts of interest declared.

References