Obstructive sleep apnoea and type 1 diabetes mellitus

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Introduction
OSA is a common and frequently unrecognised disorder with a prevalence of approximately 4% in middle-aged men and 2% in middle-aged women.1 It is often found in patients with obesity and type 2 diabetes mellitus. This case report shows the infrequently documented link between OSA and type 1 diabetes and highlights the need to confirm the type of diabetes especially in complex and atypical cases.

Case report
A 44-year-old teacher was diagnosed with type 2 diabetes in March 2007. He was obese, weighing 135 kg, with a BMI of 34.2 kg/m². His initial HbA1c was 9.9% (85 mmol/mol) and he responded well to lifestyle changes and metformin in a dose of 850 mg three times a day. By March 2008, which was within a year of diagnosis, his HbA1c had improved to 6.6% (49 mmol/mol). Further cardiovascular assessment confirmed that he also had hypertension and hyperlipidaemia requiring treatment. He was a non-smoker and had no family history of diabetes.

In June 2008, he began feeling unwell with dramatic weight loss of 16 kg in just 3 months, osmotic symptoms and worsening of his HbA1c to 14.1% (131 mmol/mol). Although he was not ketoacidotic, the history pointed to possible type 1 diabetes. He was commenced on a basal bolus insulin regime (glargine + glulisine) which resulted in a quick recovery.

Over the next few years his weight progressively increased as well as his insulin requirement, as shown in Table 1. During one of his clinic consultations he described symptoms suggestive of OSA and was referred for formal sleep studies with the respiratory team. He was asked to stop driving until further notice as per the DVLA guidelines. He scored 12/24 in the Epworth Sleepiness Scale and his overnight pulse oximetry showed 54% desaturations per hour consistent with severe OSA. Treatment with CPAP resulted in dramatic improvement in his symptoms and quality of life.

Antibodies were also measured to clarify his uncertain diabetes classification, as this would have an impact on his management options. If he indeed had type 2 diabetes, other treatment options could include a GLP-1 analogue or bariatric surgery to assist with weight loss and improving glycaemic control. Many NHS weight centres offer bariatric surgery for weight loss to people with type 1 diabetes, but there is no NICE guidance for type 1 diabetes and bariatric surgery. In the interim he was again tried on metformin 500 mg once daily and up-titrated to 1 g twice a day for insulin sparing effect.

Six months after metformin initiation he had lost 7.5 kg in weight and his insulin requirement was reduced by half with no deterioration in his glycaemic control. LADA, a subtype of type 1 diabetes, was subsequently confirmed by a positive anti-GAD antibody test of 62.7 IU/mL (normal range 0–10 IU/mL). His islet cell antibodies were negative.

Discussion
The relationship between OSA and type 2 diabetes is well established with a prevalence of 23–50%2 with obesity playing a major link between the two conditions. A few studies have now shown an unexpectedly high prevalence as well in type 1 diabetes patients. Borel et al3 and Manin et al4 showed a prevalence of 40% and 46% OSA syndrome respectively in their type 1 diabetes groups. In both studies the type 1 diabetes patients were lean, showing an independent relationship with obesity. Pharyngeal neuropathy, as part of autonomic neuropathy, has been suggested as a possible explanation.3

Undiagnosed and untreated OSA can mount a significant health and economic burden to the NHS. There is an independent association between OSA and hypertension which increases cardiac and stroke risk.5,6 Excessive daytime sleepiness can lead to poor productivity at work, motor vehicular accidents and over-

Abbreviations and acronyms
BMI body mass index
CPAP continuous positive airway pressure
DKA diabetic ketoacidosis
DVLA Driver and Vehicle Licensing Agency
GAD glutamic acid decarboxylase
GLP-1 glucagon-like peptide-1
HbA1c glycated haemoglobin
LADA latent autoimmune diabetes of adulthood
NHS National Health Service
NICE National Institute for Health and Care Excellence
OSA obstructive sleep apnoea

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http://dx.doi.org/10.15277/bjdvd.2015.020
nosis of DKA should always be re-examined if there is a query about the type of diabetes.

detected in 70–80% of patients with type 1 diabetes.9 Although not having insulin deficiency. The clinical presentation and diagnosis of DKA is uncertain and different management options have to be explored, as in our patient. Recently, urinary C-peptide is increasingly being used to differentiate type 1 from type 2 diabetes, although this test is more useful when done 3–5 years after diagnosis when the majority of patients with type 1 diabetes will have low C-peptide.10

By definition, our patient has LADA. He had the typical phenotype of type 2 diabetes with positive GAD antibody and slowly progressive beta-cell failure requiring insulin after six months of diagnosis (our patient was commenced on insulin 15 months after diagnosis). Juneja et al11 found that only islet cell antibodies and GAD antibodies defined LADA, and not BMI, age or clinical presentation. However, making this distinction is largely academic as LADA is actually a subset of type 1 diabetes and the treatment in both of these groups is similar with insulin therapy.

One of the most remarkable patient outcomes in this case is the massive reduction in insulin requirements since the re-initiation of metformin therapy, even though our patient was found to be type 1 diabetic. A randomised double-blind trial by Meyer et al12 showed that metformin has an insulin-sparing effect in lean type 1 diabetic patients. The same beneficial effect was also found in overweight type 1 diabetic patients.13 However, the average reduction in insulin requirement in these studies was about 20%, unlike in our patient where there was 50% insulin sparing effect.

In summary, there is a strong association between type 1 diabetes and OSA, and this case serves as a reminder of the importance of screening for OSA in this patient group due to its serious implications. Our patient had a vastly improved quality

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<td>180</td>
<td>190</td>
<td>207.5</td>
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</table>

**Key messages**

- There is a strong association between type 1 diabetes mellitus and obstructive sleep apnoea.
- Studies have shown that prevalence of obstructive sleep apnoea of up to 40-45% in their type 1 population group, with an independent relationship with obesity.
- Recognition of this association is important as once diagnosed, there is effective treatment leading to improvement in quality of life.

- There is a strong association between type 1 diabetes mellitus and obstructive sleep apnoea.
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- Recognition of this association is important as once diagnosed, there is effective treatment leading to improvement in quality of life.
of life and was able to resume driving. According to the DVLA, driving must cease until satisfactory control of symptoms has been attained, as did this patient.

**Conflict of interest** None.

**Funding sources** None.

**References**


