

Taste and smell in diabetes

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Diabetes affects all body systems but some complications are less familiar than others. We still have much to learn about how diabetes affects smell (olfaction) and taste (gustation). Yet olfactory and gustatory impairment (the latter usually follows the former) can be devastating.

'I seemed to have permanently lost my sense of taste and smell ... I was in despair. Would they ever come back? Until you lose them, you have no idea how much pleasure they bring to everyday life. A stressful day is soon forgotten by the aroma of a dinner of roast chicken and a glass of Rioja ... I dreaded meals because I was able only to tell what I was eating by the texture and a faint taste of either sweet or sour.'¹

'It's so hard to explain but losing your sense of smell leaves you feeling like a spectator in your own life, as if you're watching from behind a pane of glass.'²

'When I was at university someone left the gas on by accident. I was home all day but never noticed. At about 3pm my flatmates returned and I was in a bit of a daze but had no idea why. They smelt gas as soon as they walked in the door.'³

Smelling and tasting

When chemicals in the air are dissolved in the mucus in the nasal passages they are detected by olfactory receptors on the olfactory sensory neurones which transmit the information via the olfactory nerve to the olfactory bulb.

Taste is more complex. It involves a sense of smell, a normal tongue and mouth, salivation, and normal Vth, VIIth, IXth and Xth cranial nerves. Chemicals in food and other substances in the mouth are detected by taste receptor cells on the papillae of the tongue and in the mouth and throat. Basic flavours are sweet, sour, salt, bitter, and umami (savoury or meaty taste). Texture, temperature and pungency/spiciness (e.g. chili) are also important in appreciation of food, and olfaction plays a major role. The lingual nerve carries somatic sensation from the tongue to the mandibular division of the trigeminal nerve. Taste is transmitted by the chorda tympani (front two-thirds of the tongue) which joins the facial nerve, and the glossopharyngeal nerve (back of the tongue). The tongue is very vascular. The pharynx is served by the Xth cranial nerve.

Both senses are difficult and time-consuming to test. Methodology has changed over time. Assessments need to be corrected for age, gender, smoking, alcohol, and cognitive problems among other variants. While anosmia or ageusia are obvious, more subtle abnormalities may remain undetected.

How common is smell and taste impairment?

Among a German population aged 25–75 years, 3.6% had functional anosmia, and 18% had hyposmia. About 20% had gustatory impairment. Men were more likely to have impairment than women, as were smokers.⁴

In Sweden, 1387 adults were tested for olfactory dysfunction which was found in 19.1% (13.3% with hyposmia

and 5.8% with anosmia). Logistic regression analysis found overall that impaired sense of smell was associated with ageing, male sex and nasal polyps, but not diabetes or smoking. However, among those with anosmia, diabetes mellitus and nasal polyps were risk factors.⁵

Both taste and smell diminish with age and are influenced by genetic and psychological factors. Olfaction may vary during the menstrual cycle. Alcohol also affects taste and olfaction. Altered smell and taste sensation may be an early sign of dementia or Parkinson's disease.

The most common causes of impaired smell (hyposmia) are nasal and sinus disease, upper respiratory tract infections, head injury and neurodegenerative disorders. The most common causes of impaired taste (hypogeusia) are oral and perioral disorders, e.g. periodontal disease, dentures and other oral appliances, and dental procedures, and Bell's palsy.⁶

Smell and taste in diabetes

Neuropathy

Cranial diabetic neuropathies are rare (0.05% of all diabetic neuropathies), usually involving III, IV, VI, and VII. They are thought to be due to microvascular infarcts.⁷ Their rarity may be because they have not been sought. It would seem odd for cranial nerves to be spared diabetes damage. Cruccu *et al.* found that 13/23 patients with severe diabetic polyneuropathy had mandibular trigeminal dysfunction on testing.⁸

Diabetic autonomic neuropathy can cause gustatory sweating – facial sweating precipitated by spicy or highly flavoured foods. Avoiding these foods may help and antimuscarinic drugs, e.g. propantheline, are sometimes used. Such patients are likely to have other evidence of autonomic neuropathy, e.g. postural hypotension, and this should be sought.

A Scottish study found no difference in taste between controls and insulin-dependent diabetic subjects, but noted increased salivation in those with diabetic autonomic neuropathy.⁹

Smell

Severe diabetic foot or leg infections often smell unpleasant, usually because of anaerobic organisms. One wonders why some patients appear to have ignored the smell for so long. Patients with diabetic foot problems usually have multiple tissue damage including significant vasculopathy and/or neuropathy. Do some people with diabetes have olfactory impairment? Research suggests that they do.

A French group studied olfaction in patients with type 1 diabetes of less than one year duration. The 68 with diabetes had significantly poorer sense of smell than the 30 controls. Univariate and multivariate analyses – including age, sex, body mass index, blood pressure, smoking and alcohol – confirmed this. Among those with diabetes increasing age, diabetes duration, microalbuminuria and peripheral neuropathy all

worsened olfaction.¹⁰ A different study showed that people with diabetes had difficulty in identifying odours and this problem appeared to be associated with age and macrovascular disease.¹¹

A Canadian group confirmed overall impaired olfaction in people with diabetes versus controls. Small subgroup analysis showed that it was the patients with painful diabetic neuropathy who had significantly impaired olfaction. The presence of neuropathic pain may contribute to poor performances on olfactory testing in diabetic patients.¹²

A Greek study among 154 adults, 119 with type 2 diabetes, found on multivariate analysis that type 2 diabetes and hypertension were independently associated with worse olfactory scores. Diabetes impaired scores were for odour threshold and for odour identification. Scores were lower in the presence of diabetic peripheral neuropathy or retinopathy. Diabetic patients without complications had the best olfactory score. Glycated haemoglobin was not associated with olfactory score.¹³

Taste

Studies in 1961 and 1981 showed no difference in taste sensation between people with or without diabetes.^{14,15} However, subsequent studies have reported reduction in taste in people with diabetes.

In France, 57 patients with type 1 diabetes and 38 controls were studied using electro- and chemical gustometry. Among those with diabetes, 73% had impaired taste versus 16% of the non-diabetic controls. For the whole population, multivariate analysis found that taste sensation worsened with greater age, smoking and higher glucose level. Among the diabetic group, 78% of the 40 with complications had impaired taste (this included six with ageusia) versus 44% of those without complications. In this group, hypogeusia was linked with age and diabetes duration, and with peripheral neuropathy, but not with glycaemia. Taste impairment particularly applied to sucrose or similar tastes.¹⁶

Duration of diabetes may be relevant. Electro-gustometry found that people with newly-diagnosed type 2 diabetes had impaired ability to taste glucose which improved with improving glucose control. A group of neuropathic patients with established diabetes had impaired electrical and chemical thresholds for taste, but less so than the newly-diagnosed patients.¹⁷

Serially diluted glucose solutions were used to test taste threshold in 70 people with type 1 diabetes and 70 controls in India. Those with diabetes had a markedly increased threshold for glucose taste, and a significantly increased threshold for other taste modalities.¹⁸

The sweet taste receptors (STRs) T1R2 and T1R3 have been found in the intestine. Patients with type 2 diabetes and controls were studied. Duodenal biopsies before and after intraduodenal glucose infusion showed that initial STR transcription levels were unaffected by variations in blood glucose in subjects with or without diabetes. After the glucose infusion, T1R2 transcript levels increased in both groups while euglycaemic. With hyperglycaemia, the levels rose in the type 2 patients but fell in the controls. This may increase glucose absorption in people with diabetes and worsen postprandial glucose rise.¹⁹

Drugs

Metformin produces taste disturbance (usually a metallic taste) in 1/10–1/100 patients. Glibenclamide can also cause a metallic taste. Many other drugs can cause dysgeusia (alteration of taste), e.g. antibiotics, antihypertensives (e.g. ACE inhibitors, losartan), tricyclic antidepressants (e.g. amitriptyline), statins (e.g. fluvastatin and pravastatin), pregabalin, antithyroid drugs and anti-epileptic drugs.

Oral problems in diabetes

Dry mouth due to hyperglycaemia is common. People with diabetes may have glossitis or atrophic patches on their tongues. They are more prone to gingivitis, periodontal disease, burning mouth syndrome and other oral diseases such as candidiasis.

Treatment

The first step is for the patient and clinician to recognise that there is a problem. Anosmia or ageusia are obvious, lesser impairment not so. Most of us do not know how to test these senses properly – so, if impairment is suspected, ask an expert. Warn patients with olfactory impairment about the need for care with gas and other dangerous inhalants. Warn those with gustatory impairment of the need for care with unfamiliar or very spicy foods. Warn patients that they may be tempted to eat too much sweet, sugary food because they cannot taste it properly.

If a patient has impaired smell or taste, seek treatable causes such as nasal or sinus disease (e.g. polyps), or oral problems. ENT or dental referral is required for detailed assessment. Review medication.

Sadly, in many cases there is little treatment. Advise good oral and dental hygiene and regular dental care. Support smoking cessation. Provide artificial saliva for a dry mouth. Although evidence for improvement of hyposmia or hypogeusia with glucose control is lacking, it seems sensible to improve glucose control if poor. Remind patients who have problems tasting sugar to avoid it, not increase it. Steroids have been used under specialist guidance if inflammatory or autoimmune processes are suspected.

Summary

Most studies of olfaction and taste in people with diabetes show impairment. This seems to be worse in complicated diabetes. Several studies have shown an impaired ability to sense sucrose or glucose. This may increase sugar intake, and worsen postprandial hyperglycaemia. Newly-diagnosed patients seem to differ from those with established diabetes. Oral and dental disorders and treatment may alter taste. So can many drugs used in diabetic patients.

The ability to smell and taste is vital to the enjoyment of life. More awareness and research are needed to understand how diabetes affects olfaction and gustation.

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