When to consider antiobesity drugs or bariatric surgery

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Article points

1. Weight loss should be the primary goal for all overweight and obese individuals with type 2 diabetes.
2. Behavioural modification, focussing on diet and physical activity, is the cornerstone treatment.
3. Antiobesity drug treatment can make an effective contribution to motivated patients with a structured weight management programme.
4. For selected, severely obese individuals who have failed to lose weight by non-surgical means despite expert support and who meet specific criteria, bariatric surgery can be an excellent treatment option.

Key words

- Obesity
- Bariatric surgery
- Antiobesity agents

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Most people with type 2 diabetes are either overweight or obese, and many are severely so. Although the potential benefits of weight loss for people with type 2 diabetes are profound, weight loss is seldom a major treatment goal, and many diabetes-trained healthcare professionals remain ill-equipped to help patients tackle their obesity. This article examines the current evidence for offering antiobesity drugs or bariatric surgery in the routine management of type 2 diabetes and suggests when and in whom these treatment modalities should be considered.

Obesity is intimately linked with type 2 diabetes (Colditz et al, 1995; Chan et al, 1994), and the overwhelming majority of people with type 2 diabetes are overweight or obese. In a recent survey of people with type 2 diabetes attending a secondary care diabetes clinic in Liverpool, as few as 14% had a healthy BMI, while 52% had a BMI >30 kg/m^2, 24% had a BMI >35 g/m^2, and 8.1% a BMI >40 kg/m^2 (Daousi et al, 2006). In the same study it was found that the presence of obesity was associated with poorer glycaemic control, increased needs for other drug therapy, and further exacerbated the risks of hypertension, dyslipidaemia and macrovascular disease. These prevalence figures far exceed the prevalence of obesity in the background population predicted from the Health Survey for England (The Information Centre, 2006), and show also that severe obesity (BMI >40 kg/m^2; grade 3 or morbid obesity) is now commonplace among people with type 2 diabetes, particularly in women – a striking and poorly understood finding. Despite the many advances in diabetes care over the last three decades, life expectancy for middle-aged people with diabetes remains lower than the population average by, on average, 8 years (Roper et al, 2001). Clearly, more effective control of type 2 diabetes has become a national imperative and there is now increasing interest in weight loss as a means to achieve this.

Short-term experimental studies in people who are overweight with established type 2 diabetes clearly showed that weight loss restores blood glucose and insulin sensitivity to near-normal (Henry et al, 1986). A variety of other studies of intensive dietary interventions – alone or in combination with exercise or behavioural therapy – also demonstrate improved glycaemic control in obese individuals with type 2 diabetes (Pinkney and Wilding, 2004). Furthermore, epidemiological data suggest that weight loss reduces mortality in people with diabetes by around one quarter (Williamson et al, 2000). It would follow that the ideal treatment to prevent and control diabetes would emphasise caloric restriction, physical activity and weight loss. So, what do antiobesity drugs and bariatric surgery have to offer?

Antiobesity drugs

Currently, there are three antiobesity drugs licensed in Europe for long term treatment – orlistat (Xenical; Roche, Welwyn Garden City), sibutramine (Reductil; Abbot, Maidenhead) and rimonabant (Acomplia; Sanofi-Aventis, Guildford).

Orlistat is an inhibitor of intestinal and

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1. Orlistat is an inhibitor of intestinal and pancreatic lipases that induces weight loss by reducing fat absorption.
2. Sibutramine is a drug that reduces appetite by acting on the brain to inhibit re-uptake of the neurotransmitters serotonin and norepinephrine.
3. Rimonabant is a cannabinoid receptor antagonist that brings about weight loss by reducing appetite through the inhibition of reward centres in the brain and peripheral metabolic effects.
4. Before an antiobesity drug is considered the first steps in weight management should always be non-pharmacological.

pancreatic lipases and can result in a 30% reduction in the absorption of dietary fat.

Sibutramine is a drug that acts on the brain to inhibit re-uptake of the neurotransmitters serotonin and norepinephrine and is believed to exert its effects by increasing satiety and enhancing energy expenditure after meals.

Rimonabant is a cannabinoid receptor antagonist that reduces body weight mainly by reducing appetite, through an action on the reward centres in the brain. Rimonabant reduces appetite by suppressing the pleasurable aspect of eating, and also appears to have a variety of peripheral actions to reduce body fat and favourably influence the metabolic syndrome (Padwal and Majumdar, 2007). Rimonabant was licensed in 2006 for use as an adjunct to diet and exercise for the treatment of obese or overweight patients with associated risk factors, such as type 2 diabetes or dyslipidaemia.

NICE has previously summarised much of the evidence on the use of orlistat and sibutramine (NICE, 2001a; 2001b) and updated its review in 2006 (NICE, 2006), although these documents relate principally to people without diabetes and do not specifically address the potential role of antiobesity drugs in diabetes management. Although rimonabant has not yet been considered, we recommend it is used in a similar way to orlistat and sibutramine. The NICE guidance endorses the selective use of orlistat and sibutramine in highly motivated individuals treated in the context of an expert, structured, multidisciplinary management programme. What defines such a programme has been set out in the Royal College of Physicians 2003 report (*Table 1*).

Table 1. Key features of appropriate settings for antiobesity drug treatment.

- Properly trained staff, kept up to date with continuing education.
- Energy deficits calculated as targets in weight loss planning.
- Emphasis on changing behaviour, physical activity and lifestyle.
- Regular, long-term monitoring.

When to consider an antiobesity drug for a patient with type 2 diabetes

For all people newly diagnosed with type 2 diabetes it is appropriate to ask the question: 'would this particular individual benefit from a management programme that prioritises weight reduction and is there a realistic chance that the treatment could work?' If that question can be answered affirmatively – which it often can be – then antiobesity drugs are one set of tools to be considered.

However, before an antiobesity drug is considered the first steps in weight management should always be non-pharmacological. Without this, drug treatment is likely to be ineffective and a waste of resources. As emphasised by Karen Allan (Allan, 2005), it is vital to identify patients who are motivated and ready to change their behaviour and set weight loss as a long-term priority. This approach has been endorsed by both Dietitians in Obesity Management and the National Obesity Forum, the latter of which have produced an educational CD-ROM on the subject (see Alan, 2005, for more information).

In further support of the development of behaviour-based approaches to the control of type 2 diabetes, provocative preliminary data from the Look Ahead study in North America (Pi-Sunyer, 2006), presented at the American Diabetes Association conference in 2006, suggested that average weight loss of around 8% could be achieved in people with type 2 diabetes, even in those treated with oral hypoglycaemic agents or insulin. Although such responses will only be reproduced in selected individuals, they confirm a degree of reversibility in the metabolic disarray of type 2 diabetes and the power of behavioural approaches to achieve weight loss and treatment goals in motivated people with type 2 diabetes.

The use of antiobesity drugs can then be considered in selected motivated individuals with type 2 diabetes in the context of an intensive weight reduction programme addressing diet and exercise, goal setting and regular long-term follow-up. Antiobesity drugs are an adjunct to this treatment, but they may also play a role in the prevention of relapse. Their use should be viewed as a long-term treatment – not a quick fix – and to be continued only in individuals who are responding.

In the authors' clinical practice, antiobesity drugs are not prescribed to individuals who have not yet exhibited substantial readiness and motivation to change. There are in effect no data on the optimum timing and duration of antiobesity drug therapy in people with type 2 diabetes. If these drugs are to be used, it is the authors' preferred practice to consider their use soon after diagnosis; earlier in the course of diabetes rather than later; at a time when insulin

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1. People who take large portion sizes, high carbohydrate intake, or other inappropriate snacking behaviour may be more likely to benefit from an appetite suppressant like sibutramine or rimonabant.
2. An individual with a relatively high dietary fat content might achieve better outcomes with a combination of dietary re-education reinforced by orlistat treatment.
3. A 3-month trial of an antiobesity drug could be considered for selected individuals who have prioritised weight loss and already committed to a structured programme of support.
4. Most people with type 2 diabetes are overweight or obese and that antiobesity drugs increase the proportion of people achieving significant weight loss.

resistance and β-cell dysfunction can recover to some extent; and in conjunction with a major drive for lifestyle improvement. If required, weight-neutral hypoglycaemic therapies may also be preferable, although there are few data on how best to combine antiobesity and hypoglycaemic drug treatments.

When using any antiobesity drug, the pivotal importance of supporting people to change their behaviour has been highlighted by Thomas Wadden and colleagues (Wadden et al, 2005). Weight loss was found to be greatest in people receiving sibutramine when drug treatment was combined with intensive behavioural support delivered through group sessions (average weight loss: 12.1 kg). Intensive behavioural support on its own was less effective (average weight loss: 6.7 kg), as was sibutramine with only brief support (average weight loss: 7.5 kg). Sibutramine without any other intervention at all was the least effective treatment (5 kg). This study showed that an antiobesity drug could make an important contribution to weight loss, but emphasised the need for professional support and behavioural change. Other useful messages from this study, which are transferable to the diabetes clinic, were the success of their group-based treatment approach and the observation that those participants who were better at monitoring their food intake achieved the best overall results.

Since many individuals with type 2 diabetes will benefit from weight loss and be eligible for treatment, based on licensed indications, a 3-month trial of an antiobesity drug could be considered for selected individuals who have prioritised weight loss and already committed to a structured programme of support, such as described above. This is a good way to select the more motivated treatment responders who will benefit most from longer-term treatment.

Which antiobesity drug for which individual?

We recommend individualised drug treatment choices. People who enjoy large portion sizes, high carbohydrate intakes, or persist with other inappropriate snacking behaviour are more likely to benefit from an appetite suppressant such as sibutramine or rimonabant. Meanwhile, an individual with a high dietary fat content might achieve better outcomes with a combination of dietary re-education reinforced by orlistat treatment. Orlistat is generally well tolerated if individuals are referred to a dietitian prior to commencing treatment and also if they register with and receive information from a helpline (that is sponsored by the manufacturers).

In the authors' view it is important for patients to have a dietary analysis by a dietitian in order to inform the choice of antiobesity drug. However, we would usually avoid orlistat in individuals with existing gastrointestinal disease or diarrhoea, in people who would be less likely to tolerate gastrointestinal side effects (such as those who are severely immobile or chair-bound) and in individuals with learning difficulties – for whom diet cannot be reliably supervised.

In the authors' experience, rimonabant also represents a useful addition to the formulary since a significant proportion of people with type 2 diabetes, should they require an appetite suppressant, find themselves unable to take or tolerate sibutramine, either on account of poorly-controlled hypertension or concomitant coronary heart disease.

Although controversies remain about the place of routine antiobesity drug treatment in people with type 2 diabetes – not least its long-term cost-effectiveness – it is clear that most people with type 2 diabetes are overweight or obese and that antiobesity drugs increase the proportion of people achieving significant weight loss, which is an important treatment aim. Where a structured, supportive weight control programme is in place, antiobesity drugs are a good option for selected, motivated patients.

The decision in favour of one drug will depend upon individual considerations, including overall calorie intake, dietary fat content and the presence of specific contraindications. Where such patient education programmes are not available pharmacotherapy should not be commenced and where weight loss is absent or clinically non-significant after 3 months treatment should be withdrawn.

Currently, orlistat is licensed for a treatment period of up to 2 years and sibutramine and rimonabant for up to 12 months. The medical

value and economic cost-effectiveness of treatment beyond these points is not resolved and it remains important that individuals prescribed antiobesity drugs should be aided in finding effective strategies for long-term weight control once the drug is withdrawn.

What are antiobesity drugs likely to achieve in people with type 2 diabetes?

When antiobesity drugs are used to treat people with obesity who also have diabetes, it is important that they do not substitute effective anti-hyperglycaemic therapy and other treatments to control risk factors for cardiovascular disease (yet all three drugs will have modest beneficial effects on these parameters if modest weight loss of at least 5–10% is achieved). Weight loss of this order is well-accepted as having major metabolic and health benefits (Jung, 1997).

In randomised, placebo-controlled trials in overweight and obese people with type 2 diabetes, modest weight loss of around 2.5kg has been observed generally with both orlistat and sibutramine (Pinkney and Wilding, 2004). This is additional to the weight loss brought about through caloric restriction and physical activity alone in the placebo groups. It is important to note that in most of these trials lifestyle interventions had a greater positive impact on weight loss than either drug.

For example, in a study of orlistat (dosing: 120mg three times daily) in type 2 diabetes, weight loss of around 4kg was achieved through the lifestyle intervention in the placebo group, compared to 6kg through lifestyle change plus orlistat (Hollander et al, 1998). Clearly 6kg weight loss is a useful average level of weight loss, representing the important 5–10% weight loss for many individuals. However, in this study orlistat had relatively modest effects on HbA_{1c}, with just a 0.28% reduction at 12 months. Nevertheless, in a more recent Swedish study of obese type 2 patients treated with hypocaloric diet plus orlistat or placebo, the mean HbA_{1c} reduction was a more impressive 1.1% (Berne et al, 2005). Clearly, individual responses vary, and it is clear that better reductions in HbA_{1c} are enjoyed by those who achieve greater weight loss.

An important benefit of antiobesity drug use is that these agents increase the percentage of people achieving metabolically significant weight loss. For example, the percentage of individuals achieving >10% weight loss was increased from 23% to 54% by sibutramine (Apfelbaum et al, 1999).

In a study of type 2 diabetes, those taking sibutramine and losing >5% and >10% weight had mean HbA_{1c} reductions of 0.53% and 1.65%, respectively (Fujioka, 2000).

In the RIO-Diabetes study, obese patients with type 2 diabetes receiving rimonabant 20mg daily achieved a mean weight loss of 5.3kg at 12 months compared with 1.4kg in the placebo group. HbA_{1c} reductions in the rimonabant arm were around 0.7%. In these studies it is also evident that rimonabant substantially increases the number of individuals reaching >5% or >10% weight loss. At the 20mg dose, 49.2% of participants reached >5% weight loss, and 16.0% reached >10% weight loss, compared with just 14.5% and 2%, respectively, for the placebo group (Scheen et al, 2006).

Therefore, all three of these drugs can be useful adjuncts to weight loss programmes and substantially enhance the proportion of people achieving significant weight loss and enjoying metabolic benefits. In the best responders, the glycaemic improvements are impressive, and clearly of an order of magnitude that stands comparison with oral hypoglycaemic therapy and insulin. A range of additional modest non-glycaemic beneficial effects on cardiovascular risk factors have also been observed for all three drugs. Altogether, this is why weight management with selective use of antiobesity drugs is a potentially important strategy in the treatment of type 2 diabetes.

Bariatric surgery

The word 'bariatric' comes from the Greek words baros (weight) and iatrikos (healing).

Bariatric surgery is the term given to a family of gastrointestinal surgical procedures that lead to sustained weight loss. This does not include cosmetic procedures such a liposuction that have little or no sustained impact on weight.

Bariatric surgery is attracting increasing interest among people with diabetes who are also severely obese. It has already gained general acceptance in the treatment of people with severe obesity (grade 3, morbid obesity; BMI >40 kg/m^2), or those with grade 2 obesity (BMI 35–39.9 kg/m^2 who require long-term monitoring) who have already developed complications such as type 2 diabetes. Currently, bariatric surgery is not widely used as a strategy to control or 'cure' type 2 diabetes. Access to bariatric surgery varies considerably between countries and from one health system to another. It is unfortunate, given the high prevalence of obesity in the UK, that by international standards access to public sector bariatric surgery in the UK remains poor.

Bariatric operations

Bariatric operations fall into one of two broad categories: restrictive procedures that reduce the size of the stomach and those that combine restriction with varying degrees of malabsorption.

Gastric restrictive procedures

Purely restrictive procedures limit stomach capacity and desire for food intake. A small pouch is constructed from the proximal stomach such that it drains via a narrow opening, resulting in a degree of resistance to the passage of solid food. Weight loss results mainly from a process of dietary re-education. The most widely practised restrictive procedure in the 1980s and early 1990s was the vertical banded gastroplasty (VBG; *Figure 1*). More recently, the VBG has been superseded by adjustable laparoscopic gastric banding (LGB), a 'keyhole' technique that negates the need for stapling and does not permanently alter gastric anatomy (*Figure 2*). LGB has a good safety record and operative mortality now approaches zero in many large series.

Malabsorptive procedures

These procedures result in weight loss from malabsorption, usually with an element of gastric restriction. More recently there has been much interest in the idea that weight loss also results from altered secretion of gut peptide hormones.

Malabsorptive procedures carried out today result in an additional 10–20% weight loss than purely gastric restrictive procedures. This difference may in part explain the somewhat greater efficacy of gastric bypass (GBP) surgery over LGB in achieving short-term diabetes remission (Schauer et al, 2002; Dixon et al, 2002). It remains widespread practice to offer malabsorptive procedures to people with a BMI >50 kg/m^2. However, individual centres and surgeons often specialise in one procedure with which they have built up most experience. Currently, there is a widely held view among surgeons – at least those that the authors know and work with – that people with diabetes and people who eat sweet foods may benefit more from malabsorptive rather than pure gastric restrictive procedures. However, the evidence for this is

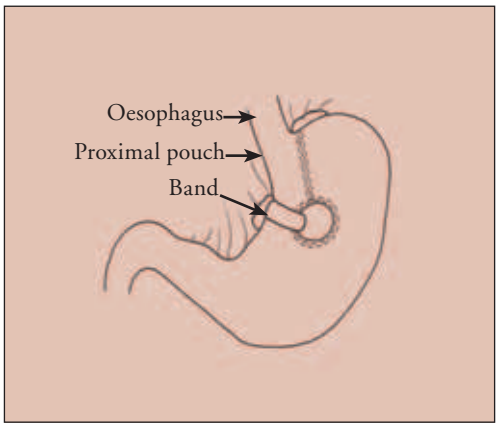

Figure 1. Vertical banded gastroplasty.

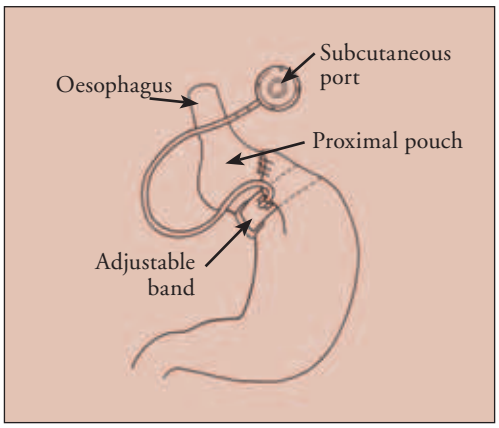

Figure 2. Adjustable laparoscopic gastric banding.

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2. Bariatric operations fall into one of two broad categories: restrictive procedures that reduce the size of the stomach and those that combine restriction with varying degrees of malabsorption.
3. The gastric bypass procedure is most widely performed type of bariatric surgery
4. Laparoscopic gastric banding is a 'keyhole' technique that negates the need for stapling and does not permanently alter gastric anatomy.
5. It remains widespread practice to offer malabsorptive procedures to people with a BMI >50 kg/m^2.

Page points

1. Common long-term complications described after gastric bypass surgery include vitamin B12 deficiency; iron, folate, calcium and vitamin D deficiency; cholelithiasis; staple line failure; and depression.
2. Malabsorptive procedures may be somewhat better than restrictive procedures for obese people with diabetes, but both types of surgery appear to be very effective in improving metabolic control or achieving remission.
3. The choice of operation usually depends on the existing BMI-based consensus criteria, the expertise and preferences of the individual surgeon and the personal choice of the individual.

debatable. People who eat a lot of carbohydrate often get dumping symptoms after GBP and by a process of aversion this leads to dietary re-education. Dumping is very common after GBP surgery but can be controlled by avoidance of refined carbohydrates.

The original procedure of this type was the long jejunoileal bypass (JIB). Unfortunately, the weight loss achieved was marred by a high frequency of serious long-term complications such as protein and vitamin malabsorption, osteoporosis and liver failure. Although JIB was abandoned in the early 1980s it created a stigma around bariatric surgery, which still persists today in the eyes of some physicians and patients. In contrast, GBP (*Figure 3*), biliopancreatic diversion (BPD; *Figure 4*) and duodenal switch (DS; *Figure 5*) are malabsorbtive operations that have seen more success. The GBP procedure is most widely performed. This surgery is performed in combination with the creation of a small gastric pouch to produce an element of gastric restriction.

Although the GBP is a safe procedure, operative mortality (1%) is higher than with LGB. GBP is, increasingly, being performed laparoscopically and this has the potential to further reduce the postoperative recovery time and complications, including incisional hernia. Common long-term complications described after GBP surgery include vitamin B12 deficiency; iron, folate, calcium and vitamin D deficiency; cholelithiasis; staple line failure; and depression. Clearly, bariatric surgery cannot be considered lightly as a primary treatment for diabetes and life-long follow-up is essential.

In summary, malabsorptive procedures may be somewhat better than restrictive procedures for obese people with diabetes, but both types of surgery appear to be very effective in improving metabolic control or achieving remission. The choice of operation usually depends on the existing BMI-based consensus criteria (National Institutes of Health Consensus Development Conference, 1992), the expertise and preferences of the individual surgeon and the personal choice of the individual. NICE has reviewed and endorsed bariatric surgery as a treatment for severe obesity and has recognised that bariatric surgery can be a highly effective treatment for comorbid problems such as type 2 diabetes (NICE, 2006).

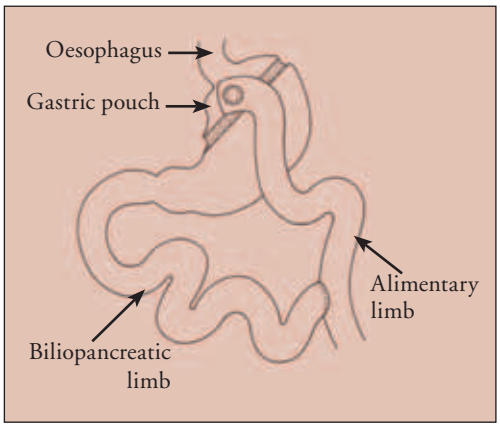

Figure 3. Gastric bypass.

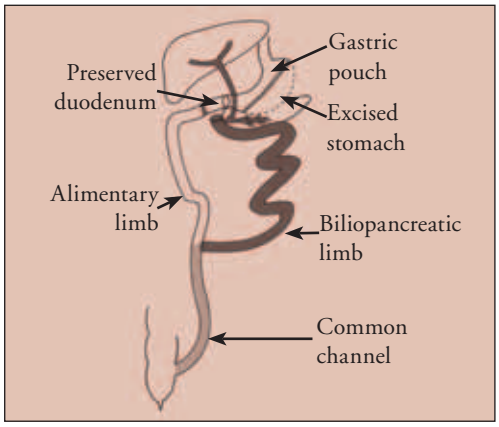

Figure 4. Biliopancreatic diversion.

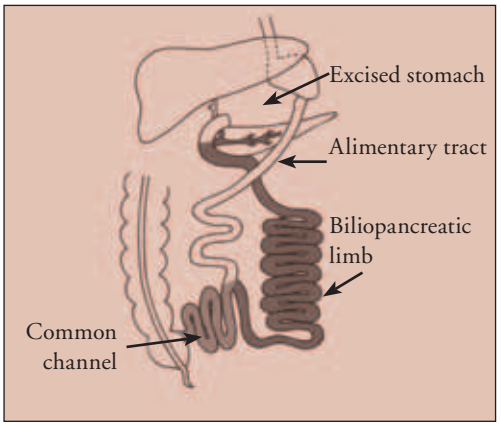

Figure 5. Duodenal switch.

Impact of bariatric surgery on type 2 diabetes

Bariatric surgery can be an excellent treatment for type 2 diabetes. One of the most astonishing

results of the Greenville study was that 82.9% of 165 severely obese individuals with type 2 diabetes remained in remission from diabetes after an average of 14 years following GBP surgery (Pories et al, 1995). In the Swedish Obese Subjects (SOS) study, various bariatric surgery procedures were compared with a non-surgical control group and the number of participants not requiring drug treatment to maintain glycaemic control after 2 years in the surgical arm was about double that in the control group (discussed in: Pinkney et al, 2001). These studies suggest that many – although not all – individuals with type 2 diabetes are able to reduce or stop their diabetes medication after surgery.

The effects of laparoscopic GBP and LGB in people with diabetes has been described (Schauer et al, 2002; Dixon et al, 2002; respectively). As expected, these studies confirm high rates of remission from treatment and biochemical remission of diabetes. Schauer et al (2002) found that 83% of individuals undergoing LGB achieved normal fasting plasma glucose. Those with the shortest duration of diabetes utilising diet-control and with the greatest weight loss achieved the best results. In a study by Dixon and O'Brien (2002) it was found that 32 of 50 (64%) patients undergoing LGB achieved remission from diabetes 1 year post surgery, where remission was defined as normal fasting plasma glucose. In this study, greater weight loss and shorter duration of diabetes also predicted remission of diabetes.

Bariatric surgery also has favourable effects on cardiovascular risk factors – another reason to consider this treatment for people with diabetes. Gleysteen and colleagues first reported the beneficial effects of GBP on diabetes, hypertension and lipid profiles (Gleysteen et al, 1990) and the SOS study confirmed these findings with both GBP and LGB (the SOS studies are reviewed in: Sjostrom, 2000).

Although it is assumed that weight loss is part of the answer to how bariatric surgery brings such benefits to people with type 2 diabetes, insulin sensitivity and blood glucose levels both improve rapidly (within one week of GBP; Pories et al, 1995), far in advance of actual weight loss. It is likely, therefore, that calorie restriction is one important mechanism, while there is now growing interest in the idea that surgically-induced changes in gut hormone secretion affecting appetite may be an additional important mechanism in weight loss (Cummings and Shannon, 2003).

Selection of individuals with diabetes for bariatric surgery

There are two main reasons why bariatric surgery might be considered for obese (BMI >35 kg/m^2) people with type 2 diabetes. Firstly, on the generally-accepted grounds of obesity-related impaired quality of life – including physical restrictions stemming from other comorbid problems such as arthritis and obstructive sleep apnoea – and secondly on the less-recognised grounds of the diabetes alone. Clinicians and prospective patients will be more familiar with the former indications, but bariatric surgery has much to offer selected individuals as a specific treatment for diabetes.

To-date, it has been uncertain to whom bariatric surgery should be offered within the many people with type 2 diabetes who might potentially benefit. Thus, it is important to realise that while improvements in and, sometimes, remission of diabetes can follow bariatric surgery, they are not seen in all who undergo such procedures. Factors predicting a good metabolic response to surgery, such as treatment withdrawal, include relatively well-preserved β-cell function, lesser degrees of insulin resistance, recent onset diabetes (within 5 years) and low treatment requirements (Schauer et al, 2002; Dixon and O'Brien, 2002).

Although some questions remain to be answered, it is clear that a high proportion of obese individuals with diabetes derive substantial metabolic benefit from bariatric surgery. Some caveats are that bariatric surgery has not been tested extensively in people aged >60 years or in children and adolescents and, pending further long-term studies, bariatric surgery should not be widely advocated for treating diabetes in these groups. Additionally, there is a consensus that bariatric surgery should be reserved for people with diabetes who have a BMI >35 kg/m^2 (National Institutes of Health Consensus Development Conference, 1992). Up to about one-quarter of people with type 2 diabetes in the authors' own secondary care diabetes clinic populations have

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Table 2. Features predictive of greater improvements in glycaemic control, cardiovascular disease risk factors, and probability in remission of diabetes following bariatric surgery.

- More recent onset of type 2 diabetes (within 5 years).
- Lower treatment requirements for good glycaemic control (for example, less insulin resistant and preserved insulin secretory reserve).
- Greater postoperative weight loss achieved.
- More rapid and moderately greater glycaemic improvement in response to gastric bypass than gastric banding.

a BMI >35 kg/m^2 and would potentially qualify. However, many severely obese individuals remain reluctant to consider surgical treatment, even in the face of poor response to pharmacological treatment. It is likely, therefore, that only a minority of potentially eligible people with type 2 diabetes would consent to surgery. An emphatic result in favour of surgery from a major controlled trial involving people with diabetes is probably required to change this in most countries.

Whether people with a BMI <35 kg/m^2 would also benefit from bariatric surgery has yet to be resolved, but if proven to be beneficial, the potential role of bariatric surgery would be widened considerably. Imposing an upper age limit restricts numbers suitable for surgery very considerably and relatively few operations are performed on individuals over 60 years of age. It is likely (but still unproven) that laparoscopic GBP and LGB procedures will be safer in older people with diabetes.

Taking into account all of these factors, it is likely that a relative minority of those with type 2 diabetes who are grade 2 obese (BMI >35 kg/m^2) would accept or be suitable for bariatric surgery as a treatment for diabetes.

Table 3. Suggested indications for bariatric surgery to treat type 2 diabetes.

- BMI >35 kg/m^2.
- Inability to achieve sustained weight loss of more than 5–10% (with non-surgical treatments including antiobesity drugs, and with expert multidisciplinary support) that is sufficient to ameliorate glycaemic control and cardiovascular disease risk factors.
- Diabetes onset within last 5 years.
- <60 years old.
- Currently controlled acceptably by diet and/or oral hypoglycaemics.
- Patient understands and accepts the operative risks versus the likely long-term effects of no surgery.
- Highly motivated, having demonstrated good dietary adherence.
- Accepts the long-term dietary limitations that gastric restriction will entail.

While modern bariatric surgery is safe in experienced centres, it is important to note that, as far as the authors are aware, few long-term comparative studies have been performed in people with diabetes and those with multiple complications (in particular, coronary heart disease) are not well represented in the available trials. Such individuals would inevitably face higher risks, since clinical and silent myocardial ischaemia are more common in people with type 2 diabetes. Taking into account all of the foregoing considerations, while many obese people with type 2 diabetes potentially have much to gain from bariatric surgery, it may be suggested that those with the most to gain are those who are younger, fitter and with a shorter duration of diabetes (*Table 2*). The major adverse impact of type 2 diabetes on life expectancy in middle-aged people (Roper et al, 2001) makes the very modest risks of bariatric surgery far more acceptable than not treating with surgery. In particular, given the increasingly younger age of onset of type 2 diabetes in the UK, which appears to be a result of the current obesity epidemic, it is often appropriate to consider bariatric surgery as an option for young adults with severe obesity and recent onset of type 2 diabetes (*Table 3*).

Conclusion

Antiobesity drugs and bariatric surgery are two important tools for the treatment of selected people with obesity, including those with diabetes and a BMI >35 kg/m^2. While it must be acknowledged that there are unanswered questions about these treatments when applied to people with diabetes, active research continues in both fields and currently both types of treatment are good options for selected individuals.

The best results from antiobesity drug treatment are realised by selective use and in the context of properly established supportive long-term treatment programmes. For the more severely obese individuals with diabetes – who have not responded well to non-surgical interventions to control weight and diabetes – who fit strict selection criteria, are highly motivated and have a good understanding of this treatment, bariatric surgery is by far the most effective potential treatment option. ■

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