

Managing diabetes in people on home enteral tube feeding

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The complexity of diabetes and its comorbidities present challenges to healthcare professionals (HCPs). Consequently, when providing nutritional support via tube feeding to people with diabetes and a functional gastrointestinal tract, HCPs have to adopt various strategies in order to manage these individuals effectively. This study aimed to determine the prevalence of diabetes in people living in Lewisham, Southwark and Lambeth PCTs who were receiving home enteral tube feeding. Current care guidelines were then reviewed in light of the results, and the need for alternative approaches to management protocols was assessed. The implications for clinical practice are discussed and recommendations to improve practice are made.

The prevalence of diabetes and its cost to the NHS are on the increase in the UK, mainly as a result of factors such as lack of physical exercise, poor dietary regimens and genetic predisposition (National Collaborating Centre for Chronic Conditions [NCCCC], 2008). Most research aimed at addressing these challenges has involved people with diabetes on conventional diets.

However, a number of people with diabetes are on enteral nutrition, partly because of the link between diabetes and other conditions such as cerebrovascular accident (CVA) in which patients may suffer dysphagia and require home enteral tube feeding (HETF). People with diabetes on HETF are often unable to maintain their nutritional requirements through oral intake alone, and their participation in exercise programmes to ensure the maintenance of normal glucose

levels is limited, partly because of neurological conditions and poor mobility (Ojo, 2010).

The management of HETF in a person with diabetes therefore presents a challenge for the multidisciplinary healthcare professional (HCP) team: unless diabetes therapy is balanced against the feed, there is an increased risk of that person developing hyperglycaemia or hypoglycaemia, which can result in potentially poorer clinical outcomes (Kerr et al, 2002). It is proposed that a good knowledge of the scale of the problem within local PCTs will enable the identification of strategies to minimise potential risks to people with diabetes on HETF and improve clinical outcomes.

Aim of the study

This study sought to determine the point prevalence of diabetes in people on HETF living in Lewisham, Southwark and Lambeth (LSL) PCTs. Results would then form the

Article points

1. The complex nature of diabetes and the difficulty in managing home enteral tube feeding (HETF) present challenges to healthcare professionals.
2. A review of people with diabetes on HETF enabled an evaluation of current management strategies to assess the need for alternative management approaches.
3. Current management strategies for people with diabetes on HETF include percutaneous endoscopic gastronomy, continuous feeding, regular blood glucose monitoring and use of short- and long-acting insulin.
4. Routine screening of people requiring HETF to exclude diabetes is recommended.

Key words

- Community
- Diabetes
- Enteral nutrition
- Tube feeding

Author's details can be found at the end of the article.

Page points

1. Review of the Home Enteral Nutrition service of Lewisham Healthcare database identified 257 adults (male and female) on home enteral tube feeding (HETF) living within the Lewisham, Southwark and Lambeth PCTs.
2. Twenty of the 257 adults on HETF had diabetes: 19 had type 2 diabetes and one had type 1 diabetes.
3. The records and data for these 20 adults were reviewed with respect to type of feed, feeding tube and medication, method of feeding and blood glucose monitoring by staff or patients.
4. Prevalence of diabetes in people on HETF was higher in Lambeth PCT (9.68%) than in Lewisham (7.92%) and Southwark (4.76%) PCTs.

Table 1. Diabetes prevalence in people on HETF in current study compared with April 2009 to March 2010 QOF data in South East London.*

Primary care trust	Total number of people on HETF	Number of people with diabetes on HETF	Diabetes prevalence in people on HETF (%)	Sum of list sizes	Sum of diabetes mellitus registers (ages 17+)	Diabetes prevalence in the general population (%)
Lambeth	93	9	9.68	375 797	12 474	3.32
Lewisham	101	8	7.92	301 234	12 607	4.19
Southwark	63	3	4.76	316 613	10 945	3.46
Total	257	20		993 644	36 026	
Mean	85.7	6.7	7.45	331 215	12 009	3.66
QOF population (%)			7.78			3.63

* Source of data: Health and Social Care Information Centre (2010); HETF=home enteral tube feeding.

basis of a review of current care guidelines and assessment of the need for alternative approaches to management protocols.

Methods

Participants

A review was undertaken of the Home Enteral Nutrition service of Lewisham Healthcare database relating to all 257 adults (male and female) on HETF living within the LSL PCTs. Twenty of these (mean age 65.45±[standard deviation 17.52 years]) had diabetes (type 1 diabetes, n=1; type 2 diabetes, n=19).

The records and data for these 20 adults with diabetes receiving HETF and living within the three PCTs were reviewed with respect to:

- Type of feed (standard or special diabetes feed).
- Type of feeding tube (nasogastric tube, percutaneous endoscopic gastrostomy [PEG] tube or percutaneous endoscopic jejunostomy [PEJ] tube).
- Type of medication (oral antidiabetes drugs [OADs] or insulin, or both).
- Method of feeding (continuous feeding or bolus feeding).
- Blood glucose monitoring by staff, the individuals themselves, or both.

The data collected were entered into an Excel (Microsoft, Redmond, USA) spreadsheet and analysed. The number of people in each of the above categories was expressed as a percentage of the total number of adults with

diabetes studied (n=20). In addition, relevant data from previous studies (Wesorick et al, 2008; Murphy et al, 2010) relating to the association between bolus feeding, continuous tube feeding and blood glucose levels were used to support the results of the current study.

The number of people with diabetes on HETF in each PCT was expressed as a percentage of the total number of people on HETF in the same PCT, and compared with diabetes prevalence in the general population living in the same PCT who were not on HETF. General population numbers were obtained from Quality and Outcomes Framework (QOF) reference data (Health and Social Care Information Centre, 2010).

Results

The prevalence of diabetes among HETF patients was higher in Lambeth (9.68%) PCT than in Lewisham (7.92%) and Southwark (4.76%) PCTs (*Table 1*). Comparison with the QOF data showed that the prevalence of diabetes in people on HETF in Lambeth, Lewisham and Southwark PCTs were higher than in the general population living within the respective PCTs and not on HETF. Similarly, overall prevalence of diabetes in people on HEFT living in the three PCTs was significantly higher (7.78%) than the prevalence of diabetes in the general population (3.63%) living in the same PCTs (*Table 1*).

Table 2. Number of people with diabetes on HETF based on management methods.

	Management methods								
	NG tube (n=2)	PEG (n=16)	PEJ (n=2)	Continuous feeding (n=19)	Bolus feeding (n=1)	Enteral feed alone (n=1)	Oral antidiabetes drugs (n=2)	Insulin (n=17)	Routine BM and regular HbA _{1c} (n=20)
Type of feeding tube (%)	10	80	10						
Method of enteral feeding (%)				95	5				
Type of treatment (%)						5	10	85	
Blood glucose monitoring (%)									100

BM=blood glucose monitoring; NG=nasogastric; PEG=percutaneous endoscopic gastrostomy; PEJ=percutaneous endoscopic jejunostomy.

Table 2 shows the percentage of people with diabetes on HETF with respect to the various methods used for managing this condition. PEG was the main type of feeding tube used, accounting for 80% of people studied, compared with nasogastric tube (10%) and PEJ (10%). Most of the people studied were on continuous feeding requiring a feeding pump (95%), with the remainder (5%) on bolus feeding.

Insulin (including short- and long-acting forms) was taken by 85% of people studied and was the primary method of treating people with diabetes on HETF; 10% took OADs and 5% did not require medication. Fifty-five per cent had CVA compared with 45% for other conditions, such as cancer of the head and neck and hypoxic brain damage. All had their blood glucose level monitored routinely, mainly by nursing home staff and community nurses, but sometimes they did it themselves. Their HbA_{1c} levels were also routinely checked via GP referrals.

Discussion

Establishing the prevalence of diabetes among people on HETF allows comparison with diabetes prevalence in the general population not on HETF and this has implications for clinical practice. It enables HCPs, such as

doctors, diabetes specialist nurses, nutrition nurse specialists, dietitians and district nurses working in this area of practice, to plan appropriate care for these patients.

The prevalence of diabetes in people receiving HETF in this study was twice that in the general population living in LSL PCTs. The reason for this may be the link between diabetes and CVA and other conditions requiring enteral tube feeding. Fifty-five per cent of the people with diabetes in this study had CVA.

It is also possible that the differences may have resulted from the underestimation of diabetes prevalence in the general population. Most people who have diabetes go undiagnosed for many years, whereas patients on HETF are monitored regularly by district nurses, community matrons and nurses in nursing homes, and are therefore more likely to be diagnosed earlier. Patients on HETF may have a higher prevalence of diabetes because they are likely to be older than the general population who are not on HETF.

The higher prevalence of diabetes in people on HETF in Lambeth PCT compared with Lewisham and Southwark PCTs could be related to variations in factors such as mix of ethnic groups and degree of social deprivation. For instance,

Page points

1. Establishing the prevalence of diabetes in people on home enteral tube feeding (HETF) allows comparison with diabetes prevalence in the general population not on HETF and this has implications for clinical practice.
2. Such comparison enables healthcare professionals, such as doctors, diabetes specialist nurses, nutrition nurse specialists, dietitians and district nurses working in this area of practice to plan appropriate care for these patients.
3. Diabetes prevalence in people receiving HETF in this study was twice that in the general population living in the same three PCTs.

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1. People from minority ethnic groups, including Asians and black people of African or Caribbean family origin, are at greater risk of developing diabetes than Caucasians.
2. The use of a continuous feeding plan for most people with diabetes on home enteral tube feeding may be a consequence of their inability to tolerate bolus feeding.
3. Bolus feeding will be more suitable for people who are mobile and prefer to engage in social activities during the day, such as people with head and neck cancer who also have diabetes.

people from minority ethnic groups, including Asians and black people of African or Caribbean family origin, are at greater risk of developing diabetes than Caucasians (NCCCC, 2008).

The fact that 80% of the people with diabetes on HETF were on PEG tube feeding and 10% on PEJ suggests that most of them were on long-term enteral feeding (Ojo, 2011); nasogastric feeding tubes are usually used for short-term feeding (Stroud et al, 2003). The use of a continuous feeding plan for most people with diabetes on HETF may be a consequence of their inability to tolerate bolus feeding. The poor mobility resulting from CVA and other neurological conditions may impair gastric emptying and reduce tolerance to a high feeding rate, while bolus feeding may increase the risk of aspiration.

The use of both short- and long-acting insulins by most people in the study (85%) may be linked to their enteral feeding regimens (Wesorick et al, 2008). Most of the people in the study were on 1500 mL of Nutrison Energy Multi Fibre (Nutricia, Trowbridge, UK) per day, running at 100 mL/h.

Although some of the research cited relates to settings other than the community, there is no reason why some of the approaches cannot be replicated in the community to support people with diabetes on HETF.

The prevalence of diabetes in hospitalised individuals has been shown to range from 12.4% to 25%, and up to 30% when those undiagnosed and those with medication-induced hyperglycaemia are included (Boucher et al, 2007).

Implications for practice

HCPs caring for people with diabetes on HETF will have to take decisions on a range of issues that could potentially affect the clinical outcomes (for example, type and size of feeding tube and method of placing the tube). Questions may need to be asked, such as “Is the person going to be on enteral feed for a short period, for example, less than 4–6 weeks, where a nasogastric tube will be more beneficial, or for a much longer period,

requiring a more permanent feeding tube?” (Stroud et al, 2003).

Individuals on long-term HETF will benefit from either PEG or radiologically inserted gastrostomy and jejunostomy tubes, depending on their physical and physiological state (Ojo, 2011).

Bolus versus continuous feeding

Bolus feeding, provided to the person on HETF intermittently, appears to resemble the usual pattern of eating and taking in fluid, thereby allowing the gastrointestinal tract to rest before the next meal. For people with diabetes having HETF and on an insulin regimen, it has been suggested that the type of insulin administered should fit around the individual’s feeding plan (Wesorick et al, 2008). According to McMahon et al (2005), bolus feeding three to four times a day results in a more physiological hormone profile.

The needs of the person with diabetes should be considered when deciding on the method of feeding as this can impact on blood glucose levels (Murphy et al, 2010). It is important to maintain good control of blood glucose in order to reduce the risk of complications in new cases of diabetes and further complications in established cases (Diabetes Control and Complications Trial Research Group, 1993). However, the prognosis of the individual is sometimes considered by HCPs when deciding how tightly the blood glucose should be controlled.

Bolus feeding will be more suitable for people who are mobile and prefer to engage in social activities during the day, such as people with head and neck cancer who also have diabetes.

However, there are some disadvantages to administering feed by the bolus method. It can increase the risk of bloating, nausea, diarrhoea and aspiration and the potential for chest infection (Bak et al, 1996). In a pilot study undertaken in six healthy subjects, Stratton et al (2008) reported that bolus feeding reduces appetite and food intake more than slow continuous infusion over many hours, perhaps owing to greater satiation and reduced appetite sensation. In contrast, continuous tube feeding

Table 3. Effects of bolus feeding versus continuous feeding on blood glucose levels*.

	Number of observations	Blood glucose level		
		<4 mmol/L	4–12 mmol/L	>12 mmol/L
20-hour feed	135	10 (7%)	58 (43%)	67 (50%)
Intermittent feed	817	33 (4%)	486 (59%)	298 (36%)
Continuous feed	702	24 (3%)	347 (49%)	331 (47%)

*Based on Murphy et al (2010).

does not reduce appetite and food intake (Stratton et al, 2003). Bolus feeding would therefore appear to be a more useful method of feeding patients in whom food intake is contraindicated for long periods of time. These issues clearly have implications for people with diabetes on HETF.

Although continuous feeding reduces the risk of aspiration and pneumonia, and can be used to address some of the limitations of bolus feeding, it does restrict individuals' mobility and thus increases their chance of developing pressure sores and depression (Bak et al, 1996). All these factors have implications for clinical practice and should be considered by HCPs involved in the care of people with diabetes on HETF.

Medications

People with diabetes on HETF are often managed in a variety of ways with respect to the administration of medication. While a few of these people may not require any form of medication to manage their diabetes, others may require one or a combination of diabetes treatments.

Murphy et al (2010) compared the effects of intermittent and continuous enteral feeding in people with insulin-requiring diabetes. In their study, 13 patients received basal–bolus insulin and intermittent daytime enteral feeding and another 15 received continuous feeding and long-acting insulin. The results of this study are presented in *Table 3*. Murphy et al found no differences in the incidence of hypo-, hyper- or normoglycaemia between intermittent and continuous feeding.

Sanz París et al (2006) recommend that short-acting insulin should be used when initiating

enteral tube feeding, and that long-acting insulin analogues are generally safe when infusion rates reach 40 mL/h. In addition, OADs can be used for people on HETF whose diabetes is well controlled (Sanz París et al, 2006).

Table 4 shows the preferred insulin regimens for different enteral nutritional situations (Wesorick et al, 2008). The physiological requirements for insulin in people with diabetes on HETF should encompass the following distinct components (Boucher et al, 2007; Wesorick et al, 2008);

- **Basal insulin:** “Insulin normally released continuously by the pancreas, even when fasting. This serves to suppress glucose and ketone production” (Wesorick et al, 2008).

- **Nutritional (prandial/meal) insulin:** “Insulin secreted in response to the intake of food. It is [the] amount of insulin required to cover enteral nutrition and other meals, snacks and/or supplements” (Boucher et al, 2007).

- **Correctional (supplemental) insulin:** “Insulin given to correct hyperglycaemia despite the administration of basal and nutritional insulin” (Wesorick et al, 2008).

The calculation of nutritional insulin for continuous feeding has been made easy by the work of McKnight and Carter (2008).

Feed

The caloric requirements of people with diabetes on HETF often have to be estimated before the feed is prescribed. According to Sanz París et al (2006), the average of a person's current weight and ideal body weight is deemed appropriate for estimating caloric requirements in order to prevent over-feeding.

There is ongoing debate among researchers and clinicians as to whether people with

Page points

1. Continuous feeding reduces the risk of aspiration and pneumonia, and can be used to address some of the limitations of bolus feeding, but it does restrict individuals' mobility and thus increases their chance of developing pressure sores and depression.
2. A study by Murphy et al (2010) found no differences in the incidence of hypo-, hyper- or normoglycaemia between intermittent and continuous feeding.
3. Sanz París et al (2006) recommend that short-acting insulin should be used when initiating enteral tube feeding, and that long-acting insulin analogues are generally safe when infusion rates reach 40 mL/h.
4. The average of a person's current weight and ideal body weight is deemed appropriate for estimating caloric requirements in order to prevent over-feeding.

Page points

1. There is ongoing debate among researchers and clinicians as to whether people with diabetes on home enteral tube feeding (HETF) should receive special feed or standard enteral feed products.
2. It is generally agreed, however, that the enteral feed selected should provide the most appropriate mix of nutrients for the individual in terms of managing his or her diabetes.
3. The management of diabetes in people on HETF involves more than formula composition: it also requires regular blood glucose monitoring and assessment of gastric motility.

Table 4. Society of Hospital Medicine (SHM) Glycemic Control Task Force recommendations: preferred insulin regimens for different nutritional situations (Wesorick et al, 2008).

Nutritional situation	Necessary insulin components	Preferred regimen*
Bolus tube feeds	Basal insulin: 40% of TDD.	Basal insulin: insulin glargine given once daily or insulin detemir given twice daily.
	Nutritional insulin: 60% of TDD, divided equally before each bolus feed.	Nutritional insulin: RAA insulin with each bolus. Correctional insulin: RAA insulin with each bolus.
Continuous tube feeds	Basal insulin: 40% (conservative) of TDD.	Basal insulin: insulin glargine given once daily or insulin detemir given twice daily.
	Nutritional insulin: 60% of TDD in divided doses.	Nutritional insulin: RAA insulin every 4 hours or regular insulin every 6 hours. Correctional insulin: should match nutritional insulin choice.

*These are the preferred regimens for most people in these situations by consensus of the SHM Glycemic Control Task Force. Alternative regimens may appropriately be preferred by institutions or physicians to meet the needs of their own patient population. RAA insulins include insulin aspart, insulin glulisine and insulin lispro. RAA=rapid-acting analogue; TDD=total daily dose.

diabetes on HETF should receive special feed or standard enteral feed products. Sanz París et al (2006) suggested that enteral formulas with less carbohydrate and more fat produce better glycaemic control than standard formulas. Glucerna (Abbott Nutrition, Columbus, USA), a specialised formula with a low carbohydrate and high mono-unsaturated fat content enriched with fibre, has been reported to improve glycaemic control (Coulston, 1998).

Elia et al (2005) compared standard nutritional formulas with diabetes-specific formulas (containing high proportions of mono-unsaturated fatty acids, fructose and fibre) in a systematic review and meta-analysis. They found that both short- and long-term use of diabetes-specific formulas improve glycaemic control compared with standard formulas.

However, it is generally agreed that the enteral feed selected should provide the most appropriate mix of nutrients for the individual in terms of managing his or her diabetes (McKnight and Carter, 2008).

Monitoring blood glucose levels and other metabolites

Coulston (1998) noted that the management of diabetes in people on HETF involves more than formula composition: it also requires regular blood glucose monitoring and assessment of gastric motility. Regular monitoring of blood glucose levels and review by HCPs are useful methods of managing people with diabetes on HETF and often this may provide an indication of the person's condition or prognosis (Sanz París et al, 2006).

Concluding remarks

The prevalence of diabetes in people on HETF in this study was double that in the general population not on HETF and living in the same three PCTs. The link between diabetes and other conditions, such as CVA, which may require enteral nutritional support, poor diagnosis of diabetes in the general population and the fact that patients on HETF are more likely to be older than the general population not on HETF may account for the observed differences in prevalence.

These findings suggest that there is a preponderance of diabetes among people at high risk of cerebrovascular disease. This calls for greater awareness and a high index of suspicion during the treatment of stroke patients. Current management strategies for people known to have diabetes and receiving HETF include PEG, continuous feeding, regular blood glucose monitoring and the use of short- and long-acting insulin regimens.

Recommendations to improve practice are shown in *Box 1*. ■

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Box 1. Recommendations to improve practice.

- The type of enteral feed prescribed for a person on home enteral tube feeding (HETF) who has diabetes should not only meet the nutritional requirements for that person, but must also have the right mix of nutrients for the individual in terms of managing his/her diabetes.
- The type of insulin administered to people on HETF who have diabetes should fit around their feeding plan (such as bolus feeding or continuous feeding).
- Bolus feeding may be an alternative to continuous feeding in people on HETF who have diabetes where there is less risk of aspiration, nausea, bloating and diarrhoea and where the individual is able to engage in other activities, including work.
- People on HETF should be routinely screened to exclude diabetes.

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