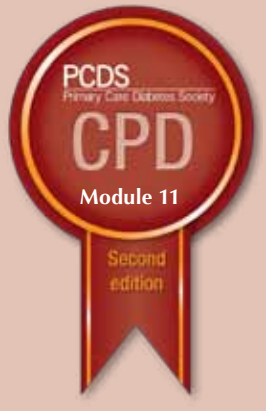
Managing hypertension in type 2 diabetes



Roger Gadsby

People with diabetes are at a high risk of developing vascular complications, all of which are known to be reduced by optimal blood pressure (BP) management. Type 2 diabetes is itself associated with hypertension, increasing the already high cardiovascular risk in this population. A variety of therapeutic options exist for the management of hypertension in people with diabetes, along with national guidelines and targets for BP measurement and treatment. This article discusses vascular risk as a function of high BP in people with type 2 diabetes, and explores the evidence and recommendations for the prevention and treatment of hypertension.

Approximately 80% of all people with type 2 diabetes die prematurely from cardiovascular (CV) complications (Emerging Risk Factors Collaboration et al, 2010). Furthermore, around 80% of people with type 2 diabetes are classified as having hypertension (blood pressure [BP], >140/90 mmHg; Barnett and O'Gara, 2003), a condition that increases the already high risk of CV disease (CVD) associated with type 2 diabetes (Hypertension in Diabetes Study Group, 1993).

The risk of developing such macrovascular complications (as well as microvascular complications such as retinopathy and nephropathy) is known to be reduced by improved BP control (UK Prospective Diabetes Study [UKPDS] Group, 1998). This article explores the evidence base for the management of hypertension in people with diabetes, discusses national recommendations and outlines the main therapeutic options available for the prevention and treatment of this condition. Although people with type 1 diabetes are also at increased risk of hypertension, much research and guidance does not distinguish between types 1 and 2 diabetes. Therefore, this article focuses on hypertension in type 2 diabetes, where it is a greatly important issue.

The evidence base

In the UKPDS BP study, 1148 people with hypertension and type 2 diabetes were randomised to either a tight BP control arm (n=758) or a less tight BP control arm (n=390). The final mean difference between the two groups was 10/5 mmHg (144/82 mmHg in the tight control group versus 154/87 mmHg in the less tight control group). Over 9 years, those assigned to the tight control arm had significant reductions in morbidity and mortality, with a 32% reduction in diabetes-related death, a 44% reduction in fatal and non-fatal stroke, a 56% reduction in congestive cardiac failure and a 37% reduction in developing microvascular complications (UKPDS Group, 1998).

People in the tightly controlled group were treated with the beta-blocker atenolol or the angiotensin-converting enzyme (ACE) inhibitor captopril, but the study was not sufficiently powered to say which agent was superior.

Further evidence for the benefit of BP lowering in type 2 diabetes comes from the HOT (Hypertension Optimal Treatment) trial (Hansson et al, 1998), which randomised 18 790 people with hypertension into three groups, aiming to achieve

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Learning objectives

After reading this article, the participant should be able to:

1. Describe the key trial data supporting the use of blood pressure (BP) management in people with diabetes.
2. Outline the components of good BP measurement.
3. Discuss NICE and SIGN targets and Quality and Outcomes Framework indicators for the management of hypertension in people with diabetes.
4. Explain the main therapeutic options for the management of hypertension in people with diabetes.

Key words

- Blood pressure
- Cardiovascular risk
- Hypertension

Authors

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Page points

1. Evidence on the beneficial effect of blood pressure (BP) lowering in people with type 2 diabetes is strong, and the NICE (2008; 2009) clinical guidelines for type 2 diabetes concluded that it is likely to be highly cost-effective in people with the condition, more so than in the general population.
2. In type 2 diabetes, hypertension is associated with insulin resistance and other features of the metabolic syndrome, including central obesity and dyslipidaemia.
3. BP measurement needs to be performed by a trained, competent person using an appropriately calibrated device in a situation where the individual being measured is relaxed, to enable an accurate and reliable figure to be obtained.

diastolic pressures of ≤90, ≤85 or ≤80 mmHg. The trial involved around 1500 people with type 2 diabetes. Significant reductions in CV morbidity and mortality were observed in the tightest control group compared with the least tight control group, the relative risk reduction being 51%.

Evidence on the beneficial effect of BP lowering in people with type 2 diabetes is strong, and the NICE (2008; 2009) clinical guidelines for type 2 diabetes concluded that it is likely to be highly cost-effective in people with the condition, more so than in the general population. Aggressive treatment of CV risk factors, including raised BP, is therefore essential to improve CV outcomes in this high-risk group.

There is evidence from the Steno-2 study that treating all CV risk factors together produces substantial risk reductions for CVD and mortality (Gaede et al, 2003). This study was carried out in 160 people with type 2 diabetes and microalbuminuria – a population at significant risk of CVD. Eighty people were randomised to conventional treatment and 80 to intensive treatment. For those who received intensive treatment, the aim was: to reduce cholesterol to ≤4.5 mmol/L, HbA_{1c} level to ≤48 mmol/mol (≤6.5%), and BP to ≤130/80 mmHg; to prescribe aspirin; and for participants to stop smoking. After the mean follow-up of 7.8 years there was a significant reduction in both macro- and microvascular disease endpoints.

An observational follow-up of the Steno-2 study reported that after 13.3 years, the benefits of tight BP control in at-risk people with type 2 diabetes continued (Gaede et al, 2008). Twenty-four people in the intensive treatment group had died compared with 40 in the standard treatment group, and intensive therapy was associated with a lower risk of death from CV causes (hazard ratio, 0.43 [95% confidence interval (CI), 0.19–0.94; P=0.04]) and of CV events (hazard ratio, 0.41 [95% CI, 0.25–0.67; P<0.001]).

Association between hypertension and diabetes

In type 2 diabetes, hypertension is associated with insulin resistance and other features of the metabolic syndrome, including central obesity and dyslipidaemia (Eckel et al, 2010).

There are several ways in which insulin resistance, hyperinsulinaemia or both could lead to hypertension. One is through the loss of insulin's normal vasodilatory activity, an action mediated by the release of nitric oxide from the endothelium (Williams and Pickup, 2004).

Insulin has other actions that raise BP and which could be accentuated by the hyperinsulinaemia that accompanies insulin resistance. Insulin promotes sodium and water reabsorption at the distal renal tubule; it also stimulates cell membrane sodium–potassium adenosine triphosphatase, which could raise intracellular sodium and potassium in vascular smooth muscle, thereby enhancing contractility and peripheral resistance (Williams and Pickup, 2004).

BP assessment in diabetes: How, when and for whom?

BP measurement needs to be performed by a trained, competent person using an appropriately calibrated device in a situation where the individual being measured is relaxed, to enable an accurate and reliable figure to be obtained (the key components of good BP measurement were described in the first version of this module [Gadsby, 2010]). Where there are any symptoms suggestive of postural hypotension, such as a feeling of dizziness on standing, it is important to check BP in both the sitting and standing position, to detect any drop in BP on standing, which is indicative of postural BP fall.

In the UKPDS (UKPDS Group, 1998), and many other hypertension outcome studies, BP was measured with a mercury sphygmomanometer. The use of mercury in medical devices has been in danger of being phased out owing to concerns about its safety by the EU (Medicines and Healthcare Products Regulatory Agency, 2006). Semi-automatic electronic sphygmomanometers are replacing the traditional mercury device in many clinics, because of these presumed safety concerns. It is vital if using a non-mercury machine to use one that has been appropriately validated. Practical information and a list of validated BP monitors can be found at: http://www.bhsoc.org/bp-monitors/bp-monitors/ (accessed 03.09.13).

Some clinics have devices that are lent to people for home BP monitoring (HBPM). As these become cheaper, some individuals are starting to buy their own. It is also possible that the use of devices for continuous ambulatory BP monitoring (ABPM) will become more widespread in the next few years.

HBPM, with its multiple measurements over time, may be found to give better prognostic information than isolated clinic readings (Petrie, 2003). However, it needs to be remembered that the thresholds and targets upon which BP management is based – in research studies and in the Quality and Outcomes Framework (QOF) – are derived from clinic measurements made with mercury devices.

Role of ABPM

In comparison with isolated measurements in the clinic, 24-hour ABPM can detect alterations in BP profiles, such as absence of nocturnal BP fall, postprandial hypotension or increased BP variability. It has the disadvantages of a relatively high cost, problems with validation of the devices and undefined diagnostic thresholds in high-risk populations, but may be indicated in people with diabetes (Parati and Bilo, 2009) when:

- Clinic values are found to be close to threshold values for treatment intervention or change. This is because these people are most likely to have "white-coat" hypertension (high BP in the clinic environment but normal ambulatory BP) or masked hypertension (when ambulatory BP will be raised). However, HBPM may be easier, cheaper and equally effective at delineating these differences.
- It is used to detect signs of end-organ damage despite apparently normal clinic BP.
- It is used to detect whether nocturnal BP is being controlled in those on antihypertensive therapy, especially where there is autonomic neuropathy or obstructive sleep apnoea.

The updated NICE (2011) guideline on primary hypertension in adults specifically excludes people with diabetes. However, that guideline has a number of recommendations about the use of ABPM and HBPM. These include:

- If a clinic BP measurement is 140/90 mmHg or higher, offer ABPM to confirm the diagnosis of hypertension.
- When using ABPM to confirm a diagnosis of hypertension, ensure that at least two measurements per hour are taken during the person's waking hours. Use an average of at least 14 measurements taken during waking hours to confirm a diagnosis of hypertension.
- When using HBPM to confirm a diagnosis of hypertension, ensure that: for each BP recording two successive measurements are taken at least 1 minute apart with the person seated; BP is recorded twice daily, ideally in the morning and evening; and BP recording continues for at least 4 days and ideally for 7 days.

The NICE (2008; 2009) type 2 diabetes clinical guidelines, which give the current recommendations on the diagnosis and treatment of hypertension in diabetes, are currently being updated and publication of the revised guideline is anticipated within the next 2 years. It is possible that the updated diabetes guideline will adopt these recommendations on ABPM and HBPM.

Intervention: Targets and guidance

NICE (2008; 2009) recommends a BP target for people with type 2 diabetes of <140/80 mmHg, and <130/80 mmHg for those with type 2 diabetes and microalbuminuria or proteinuria. For adults with type 1 diabetes, NICE (2004) recommends intervention levels of 135/85 mmHg unless the person has an abnormal albumin excretion rate or two or more features of the metabolic syndrome, in which case it should be 130/80 mmHg.

Many guidelines, however, do not distinguish between type 1 and type 2 diabetes in either the intervention and target levels for BP treatment or the BP-lowering therapies they recommend. For example, the SIGN (2010) guideline recommends an optimal BP of ≤130/80 mmHg for people with diabetes.

Trials have not shown any additional benefit by lowering systolic BP below 120 mmHg, and in some trials there is an increase in cardiovascular events below 120 mmHg, a phenomenon called the "J-curve effect" (Garcia-Touza and Sowers, 2012). This increased risk is more apparent in people over 50 years of age with long-standing hypertension and coronary heart disease (Garcia-Touza and Sowers, 2012). There is therefore evidence that there should be individualisation of BP goals below 140/80 mmHg in older people, and in those with long-standing hypertension and coronary heart disease.

QOF

In 2004, the revised General Medical Services contract for GPs introduced QOF – a "pay-for-

Page points

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Page points

1. The Quality and Outcomes Framework (QOF) diabetes clinical indicators focus on three main therapeutic interventions in people with diabetes: glycaemic control, lipid lowering and blood pressure (BP) reduction.
2. QOF results for 2011–12 gave achievement rates in diabetes for BP ≤140/80 mmHg and ≤150/90 mmHg of 65.2% (exclusion rate, 7.7%) and 86.3% (3.9%), respectively.

performance" system that rewards the attainment of both process and intermediate outcome achievement for a number of long-term conditions (NHS Commissioning Board et al, 2013).

The QOF diabetes clinical indicators focus on three main therapeutic interventions in people with diabetes: glycaemic control, lipid lowering and BP reduction. GPs are awarded points according to the percentage of people with diabetes who meet the indicators outlined in QOF. These include: total cholesterol ≤5 mmol/L; BP ≤145/85 mmHg; and HbA_{1c} level, the original indicators for which were ≤58 mmol/mol (≤7.5%) and ≤86 mmol/mol (≤10%; NHS Employers, 2006), but which have subsequently been intensified to current levels of ≤59, ≤64 and ≤75 mmol/mol (≤7.5%, ≤8% and ≤9%), respectively (NHS Commissioning Board et al, 2013).

The challenge for primary care practitioners is to implement the best possible standard of care for people with type 2 diabetes in terms of glycaemic control, lipid lowering and BP reduction, along with other CV risk factors, to improve CV outcomes. QOF data suggest that there were improvements in both process and intermediate outcome measures for CVD risk factors in diabetes in the early years after its introduction in 2004 (Gadsby, 2009; Vaghela et al, 2009).

New clinical indicators for BP targets in people with diabetes were introduced for the 2011–12 QOF year (NHS Employers, 2012) and in 2013–14 stand as shown in *Table 1*.

Achievement of BP targets in diabetes

QOF results for 2011–12 gave achievement rates in diabetes for BP ≤140/80 mmHg and ≤150/90 mmHg of 65.2% (exclusion rate, 7.7%) and 86.3% (3.9%), respectively (Health and Social Care Information Centre, 2012).

Table 1. QOF 2013–14 indicators in the diabetes domain for blood pressure.*

2013–14 indicator code, with brief summary†	Achievement threshold 	Achievement threshold 	Achievement threshold 	Achievement threshold 
DM002 Last blood pressure reading ≤150/90 mmHg	53–93%	65–70%	45–71%	51–91%
DM003 Last blood pressure reading ≤140/80 mmHg	38–78%	40–65%	40–65%	40–72%

*From *Diabetes & Primary Care* **15**: 200. †For brevity, indicator descriptions are summarised. For a full description of the indicators for your nation, please refer to the guidance with which you have been issued.

Prevention and lifestyle modification

Most of the research on the benefits of lifestyle modification in lowering BP has been carried out in people without diabetes. The recommendations on BP in the NICE (2008; 2009) clinical guidelines refer to the lifestyle recommendations of the NICE (2006) guideline on the management of hypertension in adults. This states that:

- Education about lifestyle on its own is unlikely to be effective.
- Healthy, low-calorie diets have a modest effect on BP in overweight individuals with raised BP, reducing systolic and diastolic BP on average by about 5–6 mmHg in trials. However, there is variation in the reduction in BP achieved in trials and it is unclear why. About 40% of individuals were estimated to achieve a reduction in systolic BP of 10 mmHg systolic or more in the short term, up to 1 year.
- Taking aerobic exercise (brisk walking, jogging or cycling) for 30–60 minutes, three to five times each week, has a small effect on BP, reducing systolic and diastolic BP on average by about 2–3 mmHg in trials. However, there is variation in the reduction in BP achieved in trials and it is unclear why. About 30% of individuals are estimated to achieve a reduction in systolic BP of 10 mmHg or more in the short term, up to 1 year.
- Interventions actively combining exercise and diet have been shown to reduce both systolic and diastolic BP by about 4–5 mmHg in trials. About one-quarter of people receiving multiple lifestyle interventions were estimated to achieve a reduction in systolic BP of 10 mmHg systolic or more in the short term, up to 1 year.

In those NICE (2006) guidelines, it was noted that relaxation therapies can also reduce BP and that individuals may wish to pursue these as part of their treatment. However, routine provision by primary care teams is not currently recommended. In addition, it was recommended that the alcohol consumption of individuals be ascertained and encouragement given to reduce intake if they drink

excessively, as this can reduce BP and has broader health benefits. Furthermore, excessive consumption of coffee and other caffeine-rich products should be discouraged, as excessive consumption of coffee (five or more cups per day) is associated with a small increase in BP (2/1 mmHg) in people with or without raised BP in studies of several months' duration.

An update of the 2006 guideline on hypertension in adults has been published and refers back to these recommendations and endorses them (NICE, 2011).

Drug treatment of hypertension in diabetes and NICE guidelines

The NICE (2008; 2009) clinical guidelines on type 2 diabetes give clear recommendations for the treatment of hypertension. They recommend starting with an ACE inhibitor or angiotensin II receptor blocker (ARB) if side effects of ACE inhibitor therapy (usually cough) mean that they cannot be tolerated. If full-dose ACE inhibitor therapy does not control BP to these recommended targets, NICE recommends adding a calcium-channel blocker (CCB) or diuretic (usually bendroflumethiazide 2.5 mg daily).

People of African-Caribbean descent may be relatively resistant to ACE inhibitor monotherapy and so NICE recommends using an ACE inhibitor plus either a diuretic or CCB as initial therapy.

If dual therapy with an ACE inhibitor plus diuretic, or an ACE inhibitor plus CCB, does not control BP to target, the agent not used out of the three – CCB or diuretic – should be added to give a triple-agent regimen. If a fourth agent is required, NICE recommends using an alpha-blocker, a beta-blocker or a potassium-sparing diuretic.

The updated NICE (2011) guideline on hypertension in adults gives different drug therapy recommendations for those aged under 55 and those aged 55 years and over. It should be noted that this guideline specifically excludes those with diabetes and its recommendations do not apply to people with diabetes.

NICE algorithm for BP treatment in diabetes

The NICE treatment algorithm (available in NICE [2008] and also reproduced in the previous version of this module [Gadsby, 2010]) is based on a number of trials which have demonstrated that in addition to being good agents to lower BP, ACE inhibitors (and ARBs) also exert a renal protective effect and may reduce CV risk.

Evidence for the beneficial effects of an ACE inhibitor on CV morbidity and mortality in diabetes came from MICRO-HOPE (Microalbuminuria, Cardiovascular, and Renal Outcomes – Heart Outcomes Prevention Evaluation; HOPE Study Investigators, 2000). MICRO-HOPE demonstrated that treatment of people with diabetes and a history of CV disease (or at least one other CV risk factor) with the ACE inhibitor ramipril significantly reduced the risk of myocardial infarction, stroke or CV death by 25% (P=0.0004) compared with placebo. The authors stated that the observed CV benefit of ramipril was "greater than that attributable to the decrease in BP," providing strong evidence for the use of an ACE inhibitor to reduce CV morbidity and mortality in people with type 2 diabetes.

There has been some controversy concerning this conclusion, since there were small but significant differences in BP in favour of the ramipril group by the end of the study (systolic BP was reduced by 1.92 mmHg in the ramipril group compared with an increase of 0.55 mmHg in the placebo group [P=0.0002]; diastolic BP decreased by 3.30 mmHg in the ramipril group compared with a decrease of 2.30 mmHg in the placebo group [P=0.008]). After adjustment for these changes in BP, however, ramipril still had the same effects on the primary outcome. The controversy surrounding the degree to which the outcome was influenced by the BP differences between the groups polarised opinion into those who felt that it was mostly due to changes in BP and those who felt there was a specific non-BP-related benefit (Sleight et al, 2001).

ARBs

ARBs have been shown to be at least as efficacious as ACE inhibitors in terms of achieving and maintaining BP control and are generally used in people who are intolerant to ACE inhibitors (Himmelmann et al, 2001).

Preventing or delaying the development of diabetic nephropathy is another major goal in the treatment of type 2 diabetes, and the IRMA-2 (Irbesartan in Patients with Type 2 Diabetes and Microalbuminuria) study investigated the effect of the ARB irbesartan on the development of diabetic

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Box 1. Case example one.

Clarence is a 56-year-old African-Caribbean man who was diagnosed with type 2 diabetes 2 years ago. He is on metformin 500 mg twice daily and simvastatin 40 mg daily. His blood pressure (BP) has been in the range of 130–140 mmHg systolic over 70–80 mmHg diastolic during the past 2 years. His estimated glomerular filtration rate is 60 mL/min/1.73 m^2, his total cholesterol is 4.0 mmol/L, his HbA_{1c} level is 52 mmol/mol (6.9%) and his weight has been steady at 90 kg (14 stone) over the past year (BMI, 29 kg/m^2).

At his latest 6-monthly review his weight was 95 kg (15 stone) and his BP was 150/90 mmHg (over three readings). He has recently had an extended stay in Jamaica caring for an elderly relative and says he has over-eaten and not done any exercise.

Could Clarence, by losing weight and doing more exercise, reduce his BP without medication?

Clarence asks if he can try to lose weight and do more exercise to see if he can get his BP lower without medication. After 6 weeks he has re-started walking 2 miles a day, has cut down on food and has lost 3 kg (7 lbs). His BP is 145/85 mmHg. After a further 6 weeks his weight is back down to 90 kg and his BP is 140/80 mmHg. After a further 6 months his weight is steady but his BP has risen to 150/90 mmHg (over three readings). Should he now have BP-lowering therapy?

Together you agree with Clarence that now is the time to start BP-lowering therapy. What therapy should be recommended?

NICE (2008; 2009) recommends an angiotensin-converting enzyme (ACE) inhibitor plus either a diuretic or a calcium-channel blocker as first-line therapy in someone of African-Caribbean background as the person may be relatively resistant to ACE inhibitors (or angiotensin II receptor blockers) alone. Clarence agrees to start amlodipine at 5 mg daily.

nephropathy in hypertensive people with type 2 diabetes and persistent microalbuminuria (Parving et al, 2001). Treatment with irbesartan (300 mg/day) was associated with a 70% decrease in progression to overt diabetic nephropathy compared with placebo (P<0.001). Interestingly, the renoprotective effect of irbesartan was independent of its BP-lowering effects.

Further evidence for the beneficial effect of ARBs on reducing the rate of progression of renal disease in people with type 2 diabetes was provided in the RENAAL (Reduction of Endpoints in NIDDM with the Angiotensin-II Antagonist Losartan) study (Brenner et al, 2001). People with type 2 diabetes and nephropathy receiving losartan had a 16% reduction in the combined endpoint of a doubling of serum creatinine concentration, progression to end-stage renal failure or death (P=0.02). Again, the beneficial effects of an ARB exceeded those attributable solely to a change in BP in people with type 2 diabetes and nephropathy.

Antihypertensive agents that can prevent or delay the development of diabetic nephropathy provide a major improvement in the treatment of people with type 2 diabetes. The importance of the evidence gained from the IRMA-2, RENAAL and MICRO-HOPE studies has been reflected in QOF – it is recommended that people with diabetes are tested for microalbuminuria, and that those with proteinuria or microalbuminuria are treated with an ACE inhibitor or an ARB (NHS Commissioning Board et al, 2013).

The studies described above indicate that the ACE inhibitor and ARB classes of drugs can be renoprotective in people with diabetes. It is important to remember that impaired renal function is itself a risk factor for CVD (Yuyun et al, 2005). For example, microalbuminuria doubles the risk of a CV event in people with type 2 diabetes even after adjusting for traditional risk factors (Karalliedde and Viberti, 2004).

Controversy relating to beta-blocker use in people with diabetes

ASCOT-BPLA (the Anglo-Scandinavian Cardiac Outcomes Trial-Blood Pressure Lowering Arm) was designed to compare the effects of a beta-blocker (atenolol) plus a thiazide (bendroflumethiazide) with a CCB (amlodipine) plus an ACE inhibitor (perindopril) on the primary prevention of CVD in people with hypertension with at least three other CV risk factors (Dahlöf et al, 2005). Twenty-seven per cent of participants in each treatment arm had type 2 diabetes at baseline.

The trial did not reach its primary endpoint of non-fatal myocardial infarction (including silent myocardial infarction) and fatal coronary heart disease because it was stopped prematurely owing to the higher incidence of CV events and deaths in the beta-blocker plus thiazide arm. Furthermore, there was a statistically significant 30% increase in new-onset diabetes in those allocated to the atenolol-based regimen compared with the amlodipine-based regimen (P<0.001). The finding that the amlodipine-based regimen prevented more CV events and induced less diabetes than the atenolol-based regimen led to a re-evaluation of the treatment guidelines for hypertension in diabetes and moved beta-blockers down to be a possible choice at level four when an ACE inhibitor plus a diuretic plus a CCB does not control BP to target.

CCB or diuretic first after ACE inhibitor (or ARB) therapy?

Data to inform the debate as to whether a CCB or diuretic should be added as second-line therapy to the ACE inhibitor (or ARB) was published several years back. In the ACCOMPLISH (Avoiding Cardiovascular Events Through Combination Therapy in Patients Living with Systolic Hypertension) trial of people with hypertension and diabetes (Weber et al, 2010), an ACE inhibitor (benazepril) was used in combination with the CCB amlodipine or combined with the diuretic hydrochlorothiazide. The ACE inhibitor plus CCB combination was superior in reducing CV events.

In an editorial published at that time, the role of diuretics in treating hypertension in people with diabetes was firmly endorsed (Cruickshank, 2010).

While this debate continues, the NICE (2008; 2009) recommendation that either a CCB or a thiazide diuretic be added to the ACE inhibitor (or ARB) as second-line therapy remains valid.

Treating the older person with diabetes and hypertension

Recent international guidelines on older people with diabetes (Sinclair et al, 2011) recommend

that 140/80 mmHg is a suitable threshold for treatment in non-frail older individuals below 80 years of age, but that above 80 an acceptable BP on treatment is a systolic of between 140 and 145 mmHg and a diastolic of less than 90 mmHg. For frail elderly people, where avoidance of heart failure and stroke may be of greater relative importance than preventing microvascular disease, an acceptable BP is below 150/90 mmHg.

Conclusion

Inhibitors of the renin–angiotensin system are the first treatments of choice for hypertension in people with diabetes, based on the CV and renal benefits evidenced by current clinical trial data. When BP pressure targets are no longer achieved with monotherapy, treatment combinations should be used in line with the NICE (2008) treatment algorithm. BP-lowering agents and other therapeutic agents that have additional beneficial effects beyond those attributable to their primary function should form the basis of future best-practice management of people with type 2 diabetes to improve outcomes.

QOF encourages healthcare professionals not only to improve glycaemic control in people with diabetes but to also provide optimal, evidence-based treatment of other risk factors. Despite current best practice, the incidence of CV morbidity and mortality is still two-fold greater in people with type 2 diabetes than in the general population (Emerging Risk Factors Collaboration et al, 2010).

CVD is the biggest killer in people with type 2 diabetes, and aggressive BP-lowering approaches may confer greater benefits on CV outcomes in these individuals than in those without diabetes.

Elevated BP should be treated early and intensively, following the NICE (2008; 2009) treatment recommendations, as achieving good BP control is vitally important in achieving optimal CV outcomes in people with type 2 diabetes. In the meantime, we must look to optimise our care with informed decision-making using the tools that are available to us.

Finally, *Boxes 1* and *2* provide case examples highlighting some practical issues encountered in the management of people with diabetes and hypertension. ■

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Box 2. Case example two.

Margaret is 74 years old and has had type 2 diabetes for 10 years. She is on simvastatin 40 mg daily, metformin 1 g twice daily, gliclazide 160 mg twice daily, lisinopril 20 mg daily and amlodipine 10 mg daily. Her BMI is 26 kg/m^2, her estimated glomerular filtration rate is 50 mL/min/1.73 m^2, her HbA_{1c} level is 57 mmol/mol (7.4%) and her blood pressure (BP) is 160/85 mmHg (over three readings).

Margaret has some osteoarthritis of her knees and does as much physical activity as this allows. Should a further BP-lowering agent be added?

Margaret's BP is significantly above the NICE (2008; 2009) target of <140/80 mmHg, and after discussion you both feel that another BP-lowering medication should be indicated. NICE recommends that a diuretic be used in this situation; bendroflumethiazide 2.5 mg daily is therefore added to her regimen. Within 3 months her BP has dropped to 150/80 mmHg. Is a fourth agent indicated?

Her BP has dropped but it is not yet at the NICE target of <140/80 mmHg. However, Margaret says that, as she is already taking 12 tablets a day, she does not want to take any more, so together you agree to continue and monitor her BP for a further 6 months on her current triple oral BP-lowering regimen.

Online CPD activity

Visit www.diabetesonthenet.com/cpd to record your answers and gain a certificate of participation

Participants should read the preceding article before answering the multiple choice questions below. There is ONE correct answer to each question. After submitting your answers online, you will be immediately notified of your score. A pass mark of 70% is required to obtain a certificate of successful participation; however, it is possible to take the test a maximum of three times. A short explanation of the correct answer is provided. Before accessing your certificate, you will be given the opportunity to evaluate the activity and reflect on the module, stating how you will use what you have learnt in practice. The new CPD centre keeps a record of your CPD activities and provides the option to add items to an action plan, which will help you to collate evidence for your annual appraisal.

1. What percentage of people with type 2 diabetes are estimated to die prematurely from cardiovascular complications?

   Select ONE option only.

   A. 20%
   B. 35%
   C. 50%
   D. 65%
   E. 80%

2. After 9 years of the UKPDS, which ONE of the following represents the final mean blood pressure difference (in mmHg) between the tight and less tight blood pressure control groups?

   Select ONE option only.

   A. 2/1
   B. 4/2
   C. 10/5
   D. 15/8
   E. 20/10

3. Quality and Outcomes Framework blood pressure targets are defined by research using which ONE of the following blood pressure measurement methods?

   Select ONE option only.

   A. Ambulatory blood pressure monitoring
   B. Electronic sphygmomanometer
   C. Home blood pressure monitoring
   D. Mercury sphygmomanometer

4. Which ambulatory blood pressure monitoring measurements are used to confirm a diagnosis of hypertension in adults without diabetes?

   Select ONE option only.

   A. The mean of all measurements over 24 hours
   B. The mean of all measurements excluding the first hour
   C. The mean of all measurements during waking hours
   D. The mean of all nocturnal measurements

5. Which is the MOST appropriate advice to adults without diabetes regarding the number of home blood pressure monitoring measurements needed to confirm a diagnosis of hypertension?

   Select ONE option only.

   A. Twice daily for 7 days
   B. Twice daily for 14 days
   C. Three times daily for 7 days
   D. Three times daily for 14 days
   E. Four times daily for 7 days
   F. Four times daily for 14 days

6. A 47-year-old man with type 1 diabetes has dyslipidaemia, central obesity and several raised blood pressure measurements.

   According to NICE, which is the THRESHOLD blood pressure level (in mmHg) for intervention in this situation?

   Select ONE option only.

   A. 140/90
   B. 140/85
   C. 135/85
   D. 130/80
   E. 120/80

7. According to recent evidence, which ONE of the following is MOST LIKELY to be at risk of developing a phenomenon described as the "J-curve effect"?

   Select ONE option only.

   A. A 21-year-old pregnant woman with type 1 diabetes and mean blood pressures of 100/60 mmHg
   B. A 32-year-old man with type 1 diabetes and mean blood pressures of 140/90 mmHg
   C. A 45-year-old man with type 2 diabetes, morbid obesity and mean blood pressures of 160/100 mmHg
   D. A 58-year-old man with type 2 diabetes, coronary artery disease and mean blood pressures of 110/65 mmHg
   E. A 77-year-old woman with type 2 diabetes, CKD stage 4 and mean blood pressures of 170/105 mmHg

8. A 59-year-old man has type 2 diabetes and persistent microalbuminuria.

   Which ONE of the following may PREVENT the development of diabetic nephropathy in this situation?

   Select ONE option only.

   A. Amlodipine
   B. Bendroflumethiazide
   C. Bisoprolol
   D. Doxazosin
   E. Losartan

9. A 61-year-old woman with type 2 diabetes continues to have suboptimal blood pressure control. She takes metformin 500 mg twice daily and ramipril 10 mg once daily.

   According to the ACCOMPLISH trial, which ONE of the following is the SINGLE MOST appropriate second-line antihypertensive medication?

   Select ONE option only.

   A. Amlodipine
   B. Bendroflumethiazide
   C. Bisoprolol
   D. Doxazosin
   E. Indapamide

10. An 85-year-old nursing home resident has type 2 diabetes, rheumatoid arthritis, polymyalgia rheumatic and chronic obstructive pulmonary disease.

    According to recent international guidelines, which is the recommended THRESHOLD blood pressure level (in mmHg) for intervention in this situation?

    Select ONE option only.

    A. 120/80
    B. 130/80
    C. 140/85
    D. 150/90
    E. 160/100