

# Management of hypertension in patients with diabetes mellitus

Fiona White BMedSc(Hons)<sup>1</sup>, Lexin Wang MD PhD<sup>1</sup>, Herbert F Jelinek PhD<sup>2</sup>

F White, L Wang, HF Jelinek. Management of hypertension in patients with diabetes mellitus. *Exp Clin Cardiol* 2010;15(1):5-8.

**OBJECTIVE:** To investigate the management of hypertension in patients with diabetes mellitus, living in a rural setting.

**METHOD:** A community health screening clinic was conducted at Charles Sturt University, Albury-Wodonga, in rural southeastern Australia. Patients with either diagnosed hypertension or high blood pressure who attended the clinic were eligible for inclusion in the present study. The awareness and control of hypertension was compared between patients with and without diabetes mellitus.

**RESULTS:** A total of 449 patients with hypertension were analyzed. One hundred twenty-one (26.9%) had hypertension and diabetes mellitus, and 328 (73.1%) had hypertension without diabetes mellitus. Hypertension

awareness (61.2% versus 36.9%,  $P=0.014$ ) and control (17.4% versus 7.0%,  $P=0.040$ ) were significantly better in the hypertensive patients with diabetes mellitus than in the hypertensive patients without diabetes mellitus. Antihypertensive medication use was also significantly higher in patients with diabetes mellitus than in patients without diabetes mellitus (one antihypertensive medication, 41.3% versus 25.0%,  $P=0.045$ ).

**CONCLUSION:** Awareness and control of hypertension were suboptimal in the patients in the present study. Diabetes mellitus, however, was associated with both higher awareness and better control of hypertension than having hypertension alone. This may be partially due to a higher use of antihypertensive medications by patients with diabetes mellitus.

**Key Words:** Antihypertensive medication; Awareness; Control; Diabetes mellitus; Hypertension

Diabetes mellitus is one of the most common diseases worldwide, with the number of people affected continually increasing. In Australia, type 2 diabetes is the sixth major cause of death, and its presence can shorten the normal lifespan of an individual by up to one-fifth (1).

Diabetes mellitus has a major impact on the cardiovascular system, with the main cause of death being directly related to cardiovascular disease (2-5). Major cardiovascular complications associated with diabetes mellitus include stroke, coronary artery disease, ischemic heart disease, heart failure and myocardial infarction (6-8). The risk of these complications occurring increases with the presence of cardiovascular risk factors.

Hypertension is one of the most common cardiovascular risk factors in patients with diabetes; it is present in 35% of men and 46% of women (9), and is the cause of 75% of all cardiovascular deaths in these patients (2). It is the most frequently managed problem in Australian general practice (10), and current levels of control are suboptimal. If hypertension is optimally controlled, there is potential for a 50% reduction in the incidence of potentially lethal cardiovascular events (11).

The present study investigated the management of hypertension in patients with concurrent diabetes mellitus and hypertension living in a rural setting. It is hypothesized that due to the adverse impact of diabetes mellitus on the cardiovascular system, patients with hypertension and diabetes mellitus may be more difficult to manage than those with hypertension only.

## METHOD

The present study received approval from the Charles Sturt University Human Ethics Committee. Informed written consent was obtained from all participants.

## Study background and location

The present study is part of the Diabetes Screening Complications Research Initiative (DiScRI) being conducted at the Albury-Wodonga campus of Charles Sturt University.

Participants were recruited from Albury-Wodonga and surrounding districts; Albury-Wodonga is an inland city with an approximate population of 100,000, located on the New South Wales-Victoria border in southeast Australia.

## Patient recruitment

Patients were recruited in 2004 through a public media campaign involving various media forms. These included newspaper articles, radio announcements, a news story on local television, and advertisements posted in general practice and community health centres. People were requested to contact the university if they wished to undergo a health check, and an appointment was made to attend the clinic. The only criterion for participation was that participants had to be older than 40 years of age (12).

The initial study population consisted of 703 patients; however, 38 were excluded due to an absence of blood pressure measurement data. Of the remaining 665, the 449 patients with hypertension were selected for analysis.

## Definitions

The hypertension definition and guidelines used in the present study were obtained from the *Hypertension Management Guide for Doctors 2004* (13), which was current at the time of the research. Patients were classified as hypertensive if they had a known history of hypertension and/or a blood pressure measurement that was classified as hypertensive (greater than 140/90 mmHg). When examining control of hypertension in

<sup>1</sup>School of Biomedical Sciences, Charles Sturt University, Wagga Wagga; <sup>2</sup>School of Community Health, Charles Sturt University, Albury, New South Wales, Australia

Correspondence: Dr Lexin Wang, School of Biomedical Sciences, Charles Sturt University, Wagga Wagga, New South Wales 2678, Australia.

Telephone 02-69332905, fax 02-69332587, e-mail lwang@csu.edu.au

Received for publication January 3, 2010. Accepted January 11, 2010

**TABLE 1**  
**Comparison of hypertension with diabetes mellitus and hypertension only groups**

	Hypertension with diabetes mellitus (n=121)	Hypertension only (n=328)	P
Age, years, mean ± SD	63.5±10.3	63.6±12.6	NS
Male sex	64 (52.9)	134 (40.9)	NS
Known type 2 diabetes mellitus	107 (88.4)	–	–
Years of diabetes mellitus, mean ± SD (range)	6.8±7.9 (0.1–40.0)	–	–
Blood glucose level at clinic, mmol/L, mean ± SD	6.39±4.46	5.24±1.36	0.040
Family history of diabetes mellitus	60 (49.6)	104 (31.7)	0.047
Smoking	7 (5.8)	17 (5.2)	NS
Alcohol consumption	16 (13.2)	66 (20.1)	NS
BMI, kg/m <sup>2</sup> , mean ± SD	28.56±9.50	27.71±7.03	NS
Overweight/obese (BMI ≥25 kg/m <sup>2</sup> )	90 (74.3)	242 (73.8)	NS
Awareness of hypertension diagnosis	74 (61.2)	121 (36.9)	0.014
Hypertension control in those who were aware, n/n (%)	21/74 (28.4)	19/121 (15.7)	0.055
Total hypertension control	21 (17.4)	23 (7.0)	0.040

Data presented as n (%) unless otherwise indicated. BMI Body mass index; NS Nonsignificant

patients with concurrent diabetes mellitus, the recommended blood pressure treatment goal of less than 130/85 mmHg was used, in comparison with the treatment goal of less than 140/90 mmHg in nondiabetic patients.

The diabetes mellitus definitions and guidelines were obtained from Diabetes Australia (14). Patients were classified as having diabetes mellitus if they had a known history of diabetes mellitus and/or a blood glucose measurement that was classified as diabetic (greater than 11 mmol/L nonfasting, or at least 7.0 mmol/L fasting).

Alcohol consumption and smoking were defined based on a yes or no questionnaire response, as completed by the patient. A response of 'yes' to smoking meant the patient smoked more than five cigarettes per day. A response of 'yes' to alcohol consumption meant the patient consumed more than two to three glasses of alcohol per day.

#### Data collection

Patient information was collected via a demographic and clinical history questionnaire, and a clinical measurement examination.

Information collected from the questionnaire included patient age, sex, current prescribed medications, diabetes status (including type if known), number of years with diabetes and any known family history of diabetes.

Other information was measured clinically, including blood glucose, body mass index and blood pressure. Blood glucose levels were measured using an Accu-Chek Advantage II glucometer (Roche Australia P/L), body mass index was calculated from the patient's height and weight measured at the clinic, and blood pressure measurements were taken using a standard mercury sphygmomanometer (Welsh Allyn Australia P/L). Two blood pressure readings were recorded using a cuff of appropriate size after at least 5 min rest in the supine position. If the supine position was not possible, blood pressure was

recorded in a seated position with the arm supported at the height of the heart. For each patient, the mean of two blood pressure measurements taken 1 min apart was calculated and recorded.

After all information collection and clinical measurements were completed, the research coordinator was consulted. Feedback regarding test results was provided, and recommendations with respect to follow-up were made based on relevant guidelines (12).

#### Statistical analysis

Data were expressed as mean ± SD (range). The statistical tests used for the analysis were the Student's *t* test for paired samples, ANOVA for multiple group comparison, and  $\chi^2$  for categorical data such as the awareness and control of hypertension between subgroups.  $P < 0.05$  was considered to be statistically significant in the present study.

## RESULTS

There were 449 patients with hypertension in the present study, having either a known diagnosis and/or a blood pressure level categorized as hypertensive. These patients were divided into two subgroups for analysis – a hypertension with diabetes subgroup, and a hypertension only subgroup.

#### Hypertension with and without diabetes mellitus

A total of 121 (26.9%) patients had both hypertension and diabetes mellitus, and 328 (73.1%) had hypertension only. The general findings of these patients are provided in Table 1.

Of the 121 patients with hypertension and diabetes mellitus, 88.4% had a diagnosis of type 2 diabetes, 9.1% had a diagnosis of type 1, and 2.5% of patients had not been diagnosed as having diabetes, but had a blood glucose level that qualified them as having diabetes. Of those with a known family history of diabetes, 98.3% of patients had a current diagnosis of diabetes; 10.2% of these patients had type 1, and 89.8% had type 2.

In the 328 patients with hypertension only, there were no significant differences in age or sex when compared with patients with both hypertension and diabetes mellitus ( $P > 0.05$ , Table 1). Similar results were also obtained for other lifestyle risk factors such as smoking, alcohol consumption and obesity ( $P > 0.05$ , Table 1).

The level of awareness of a previous hypertension diagnosis was greater in patients with hypertension and diabetes than in patients with hypertension only ( $P = 0.014$ , Table 1). The control rate of hypertension in those who were aware of their hypertension was also higher in the hypertension and diabetes group than in the hypertension only group ( $P = 0.055$ , Table 1). The total level of hypertension control, regardless of awareness, was also significantly higher in patients with hypertension and diabetes mellitus than in the patients with hypertension only ( $P = 0.040$ , Table 1).

A comparison of mean blood pressures between the hypertension only patients and those with concurrent diabetes mellitus is provided in Table 2.

#### Antihypertensive medication use

The overall use of antihypertensive medications and the specific number of medications used per patient of both

**TABLE 2**  
Hypertension control in subgroups with and without diabetes mellitus

	Hypertension with diabetes mellitus (n=121)	Hypertension only (n=328)	P
SBP sitting/supine, mmHg	140.9±15.2	145.1±17.4	NS
SBP standing, mmHg	135.5±15.6	141.5±20.0	<0.001
DBP sitting/supine, mmHg	83.8±8.9	86.0±9.7	0.002
DBP standing, mmHg	84.9±9.2	89.3±10.0	<0.001
Controlled hypertension, n (%)	21 (17.4)	23 (7.0)	0.040

Data presented as mean ± SD unless otherwise indicated. DBP Diastolic blood pressure; NS Nonsignificant; SBP Systolic blood pressure

subgroups are shown in Table 3. The specific classes of antihypertensive medications used are provided in Table 4.

Of the patients with hypertension and diabetes, 30.6% were not taking any antihypertensive medications, compared with 64.0% of the hypertension only patients ( $P<0.001$ , Table 3). The proportion of patients taking one or two antihypertensive medications in the hypertension and diabetes subgroup was significantly higher than in the hypertension only group ( $P<0.05$ , Table 3).

## DISCUSSION

### Hypertension control in patients with and without diabetes mellitus

There were 121 patients who had both hypertension and diabetes mellitus, and 328 patients who had hypertension only. When comparing the two subgroups, several characteristics were similar, including mean age and sex. In both subgroups, smoking, alcohol consumption, and overweight or obese body mass index appeared to be relatively uninfluenced by the presence of diabetes mellitus. There were slightly more obese hypertensive patients with diabetes than without, but the differences remained statistically insignificant at all body weights.

There were, however, some significantly different results between the two subgroups. The awareness of a diagnosis of hypertension in the hypertension with diabetes group was almost double that of the hypertension only group ( $P<0.05$ ). One possible explanation for this could be that hypertensive patients with diabetes have more frequent medical checkups than hypertension only patients, due to the highly publicized dangers of diabetes, resulting in heightened health awareness (15). More regular blood pressure checks are therefore undertaken, and hypertension is identified more readily (11).

One other possible cause of the high number of patients unaware of hypertension is that, due to a diagnosis of hypertension requiring two measurements made on two occasions, any one occasion by itself may be taken as one instance of undiagnosed or unaware hypertension.

Diabetes presence also appears to be related to better blood pressure control in those who were aware of hypertension. In the present study, when patients were aware of the diagnosis of hypertension, the proportion of patients who achieved optimal blood pressure control in the hypertension and diabetes group was significantly higher than in the patients with hypertension only ( $P<0.05$ ). This may also be due to the same mechanisms as for increased awareness. The more frequent checkups may also be more thorough due to the practitioners'

**TABLE 3**  
Number of antihypertensive medications used per patient

Medications, n	Hypertension with diabetes mellitus (n=121), n (%)	Hypertension only (n=328), n (%)	P
0	37 (30.6)	210 (64.0)	<0.001
1	50 (41.3)	82 (25.0)	0.045
2	24 (19.8)	27 (8.2)	0.030
3	8 (6.6)	5 (1.5)	NS
4	1 (0.8)	1 (0.3)	NS
5	1 (0.8)	0 (0.0)	NS
Unknown	0 (0.0)	3 (0.9)	NS

NS Nonsignificant

**TABLE 4**  
Classes of antihypertensive medications used

Class	Hypertension with diabetes mellitus (n=84), n (%)	Hypertension only (n=118), n (%)	P
ACEI	33 (39.3)	47 (39.8)	NS
ARB	33 (39.3)	35 (29.7)	NS
CCB	19 (22.6)	22 (18.6)	NS
Beta-blocker	20 (23.8)	24 (20.3)	NS
Diuretic	25 (30.0)	26 (22.0)	NS
Alpha-blocker	4 (4.8)	2 (1.7)	NS
Centrally acting alpha-2 agonist	0 (0.0)	1 (0.8)	NS
Unknown	0 (0.0)	2 (2.5)	NS

ACEI Angiotensin-converting enzyme inhibitor; ARB Angiotensin II receptor blocker; CCB Calcium channel blocker; NS Nonsignificant

increased awareness of diabetic patients' heightened health requirements. More comprehensive investigation and treatment of risk factors, and frequent review and adjustment of medication regimens, would lead to both improved awareness and control (16).

Regardless of the awareness of hypertension, the presence of diabetes mellitus was associated with a better overall control of blood pressure. In the hypertensive patients with diabetes, hypertension was controlled in 17.4% of the 121 patients, compared with only 7.0% of the 328 patients with hypertension alone ( $P<0.05$ ). This increase in the level of hypertension control in the presence of diabetes may be explained by the mechanisms stated earlier, even incorporating the lack of awareness.

### Antihypertensive medication use

The use of antihypertensive medications was also compared and analyzed to further investigate hypertension management to determine whether medication use was affecting hypertension control.

There was a significant difference in the overall use of antihypertensive medications between the two subgroups of patients. In the hypertension and diabetes group, a greater proportion of patients were being treated with antihypertensive medications, indicating that the presence of diabetes may have affected the control of hypertension via the number of antihypertensive medications being prescribed and used by patients.

In the present study, despite the fact that patients from both subgroups were hypertensive, a significant number were not

currently taking any antihypertensive medications – 30.6% of the hypertensive patients with diabetes compared with 64.0% of the hypertensive only patients ( $P < 0.001$ , Table 3). This finding of higher antihypertensive use in diabetic patients is also supported by the Hoorn study (17), which reported that the use of antihypertensive medications increased by approximately 10% in men and 20% in women when they had diabetes compared with those without diabetes. One possible reason for this increase in antihypertensive medication use by hypertensive patients with diabetes may be due to their more frequent medical checkups. As stated earlier, this would result in increased diagnoses of hypertension and prescription of antihypertensive medications, as well as more frequent medication review and adjustment.

Another reason for the large number of untreated patients with hypertension could be due to the inclusion of patients who had hypertensive blood pressure measurements but were unaware of their condition. While unaware of a diagnosis, these patients would most likely not have received any antihypertensive medication treatment.

When deciding on the treatment to enable blood pressure control, a patient's global risk is a major factor influencing the treatment decision (18). Using more than just hypertensive blood pressure measurements, a patient's global risk informs the decision that will be best suited to the individual patient and their medical condition(s), including, for instance, the most appropriate class of antihypertensive medication.

After the exclusion of the substantial number of patients in the study who were not currently using any antihypertensive medications, the remaining patients' total antihypertensive medication classes were analyzed (Table 4). Despite the lack of statistical difference between the two hypertensive subgroups,

identification of the popular drug classes was achieved based on the number of prescriptions for each medication class. Angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers were the most popular classes. Calcium channel blockers, beta-blockers and diuretics were the next most popular. The least popular, or prescribed, medications were alpha-blockers and centrally acting alpha-2 agonists. These findings were consistent with the current recommendations of the National Heart Foundation of Australia (13), so there are no obvious complications arising from the classes of antihypertensive being used.

A possible limitation of the present study is that, due to an omission in the initial design, there was a lack of detail collected regarding specific medication dosages. Therefore, in the analysis of antihypertensive medication use, the effect of dose on the level of control was difficult to determine.

## CONCLUSION

The major findings of the present study were a poor awareness and control of hypertension. In contrast to the hypothesis, both awareness and control were slightly improved with the presence of diabetes mellitus, supported by more frequent use of antihypertensive medications in patients with diabetes mellitus. The exact reasons for this slightly higher awareness and control remain unclear; however, antihypertensive medication use appeared to be an influencing factor.

**ACKNOWLEDGEMENTS:** The authors thank Cheryl Kolbe and Beverlie de Jong for their technical assistance. The Diabetes Screening Complications Research Initiative received a Charles Sturt University Community of Scholars grant.

## REFERENCES

- Martin K. The twin killers: Diabetes + obesity. *AJP* 2001;82:522-3.
- Gill GV, Woodward A, Pradhan S, et al. Intensified treatment of type 2 diabetes – positive effects on blood pressure, but not glycaemic control. *QJM* 2003;96:833-6.
- Hu G, Jousilahti P, Barengo NC, Qiao Q, Lakka TA, Tuomilehto J. Physical activity, cardiovascular risk factors, and mortality among Finnish adults with diabetes. *Diabetes Care* 2005;28:799-805.
- Niskanen L, Hedner T, Hansson L, Lanke J, Niklason A. Reduced cardiovascular morbidity and mortality in hypertensive diabetic patients on first-line therapy with an ACE inhibitor compared with a diuretic/ $\beta$ -blocker-based treatment regimen: A subanalysis of the Captopril Prevention Project. *Diabetes Care* 2001;24:2091-6.
- Stanciu I, Peralta MI, Emanuele MA, Emanuele NV. Clinical trial evidence for cardiovascular risk reduction in type 2 diabetes. *J Cardiovasc Nurs* 2002;16:24-43.
- Wang L, Wei T. Blood pressure control in patients with hypertension: A community-based study. *Clin Exp Hypertens* 2006;28:41-6.
- Jeppesen J, Hein HO, Suadicani P, Gyntelberg F. High triglycerides and low HDL cholesterol and blood pressure and risk of ischemic heart disease. *Hypertension* 2000;36:226-32.
- Roper NA, Bilous RW, Kelly WF, Unwin NC, Connolly VM. Excess mortality in a population with diabetes and the impact of material deprivation: Longitudinal, population based study. *BMJ* 2001;322:1389-93.
- National Health and Medical Research Council. National evidence based guidelines for the management of type 2 diabetes mellitus: Part 4: Blood pressure control in type 2 diabetes. Sydney: National Health and Medical Research Council, 2004.
- Briganti EM, Shaw JE, Chadban SJ, et al. Untreated hypertension among Australian adults: The 1999-2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Med J Aust* 2003;179:135-9.
- Wolf-Maier K, Cooper RS, Kramer H, et al. Hypertension treatment and control in five European countries, Canada, and the United States. *Hypertension* 2004;43:10-7.
- Jelinek HF, Wilding C, Tinley P. An innovative multi-disciplinary diabetes complications screening program in a rural community: A description and preliminary results of the screening. *Aust J Prim Health* 2006;12:14-20.
- Heart Foundation. Hypertension Management Guide for Doctors 2004. National Heart Foundation of Australia, 2003.
- Diabetes management in general practice: Guidelines for type 2 diabetes 2008/9. Canberra: Diabetes Australia, 2008.
- Roca B, Suarez C, Ceballos A, et al. Control of hypertension in patients at high risk of cardiovascular disease. *QJM* 2005;98:581-8.
- Banegas JR, Rodriguez-Artalejo F, de la Cruz Troca JJ, Guallar-Castillon P, del Rey Calero J. Blood pressure in Spain: Distribution, awareness, control, and benefits of a reduction in average pressure. *Hypertension* 1998;32:998-1002.
- Becker A, Bos G, de Vegt F, et al. Cardiovascular events in type 2 diabetes: Comparison with nondiabetic individuals without and with prior cardiovascular disease: 10-year follow-up of the Hoorn Study. *Eur Heart J* 2003;24:1406-13.
- Pedrinelli R, Esposti ED, Dell'Omo G. LDL cholesterol and global risk stratification in referred hypertensive patients. *Atherosclerosis* 2005;180:137-43.