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### Case Report

## The association between type-II diabetes mellitus and hypertension: A case report

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### ABSTRACT

#### Introduction

It is well documented that there is an association between the levels of plasma glucose concentration previous cardiac complications and blood pressure of non-diabetic individuals. However no study has reported an actual relationship among these factors in a typical clinical setting. The following case study is based on a patient with a history of IHD and hypertension, being diagnosed with uncontrolled DM type II.

#### Case presentation

This case study is based on a 53 year old female patient with a previous history of IHD and HTN, for which she was being treated with the required regime. She presented to the ER with clinical symptoms of hyperglycemia. RBS revealed that she had elevated plasma glucose levels and hence was diagnosed with type II DM.

#### Conclusion

The case study presents a clinical relationship between type II DM and HTN. The management of such patient requires adequate drug therapy and any errors in the pharmacotherapy can be rectified by inclusion of a clinical pharmacist in the health care team.

**Keywords:** Diabetes mellitus; Hypertension; Ischemic heart disease

#### Medical abbreviations

DM = Diabetes Mellitus, IHD = Ischemic Heart Disease, HTN = Hypertension, RBS = Random Blood Sugar, TLC = Therapeutic Lifestyle Change

### INTRODUCTION

An estimated 3 million Americans have both DM and HTN. Hypertension is about twice as frequent in individuals with diabetes as in those without.<sup>[2]</sup> Lifestyle and genetic factors are important factors contributing to both HTN and DM. The prevalence of coexisting hypertension and diabetes appears to be increasing in industrialized nations because populations are aging and both hypertension and DM incidence increases with age.<sup>[1,2]</sup> A proportion of 25-50% of patients already have some evidence of a vascular complication at the time of diagnosis of DM.<sup>[3]</sup> The present case study is based on a patient with a hypertension, being diagnosed with

type II DM. The case is an apt example of how co-morbidity of HTN can develop DM type II.

### CASE PRESENTATION

A 53 year old female presented to the ER with complaints of dizziness, malaise, excessive sweating, polydipsia, polyphagia, polyuria and severe headache. Upon clinical examination and investigations it was revealed that she has random blood glucose level of 449 mg/dl, her blood pressure at the time of admission was 164/88 mm of Hg and urine analysis showed glycosuria. Diagnosed with uncontrolled DM, it is important to note that she previously underwent an attack of

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angina owing to the presence of HTN since 7 years. The patient does not have any history of smoking or alcohol consumption but has had IHD in her family history. She maintained a balanced diet, exercised frequently and had a moderate body weight. The only medication she was taking at the time of diagnosis was candesartan, an angiotensin II receptor blocker ARB, given 8mg daily, as a post-cardiac event management.

### MANAGEMENT AND MONITORING

The patient suffers from hypertension, a previously existing cardiac complication i.e. angina pectoris due to IHD, as well as recently discovered DM. The goal of therapy, pertaining to the diagnosis of type II DM, is the reduction of serum glucose levels and bringing it as close to the recommended range as possible. The NICE guidelines recommend a target glucose range of 90-130 mg/dl or HbA<sub>1c</sub> <7% for patients with DM.<sup>[4]</sup> Cardiac risk calculation in association with the disease is also recommended.<sup>[4]</sup> The medication regime for the patient included the use of metformin 500mg, which is an oral anti-diabetic drug in the biguanide class. It is the first-line drug of choice for the treatment of type 2 diabetes.<sup>[5]</sup> As of 2010, metformin is one of only two oral anti-diabetics in the World Health Organization Model List of Essential Medicines, the other being glibenclamide.<sup>[6]</sup> She is also being given insulin aspartate 28 units in the morning and 14 units in the evening. The use of a second anti-diabetic agent provides efficient reduction in the increased blood glucose levels and likelihood of an episode of hyperglycemia. According to the EASD guidelines, patients with type II DM because of progressive diminution in their insulin secretory capacity, will require prandial insulin therapy with short-acting insulins. This is typically provided in the form of the rapid insulin analogs, insulin lispro (pro human insulin), insulin aspart (human insulin), or insulin glulisine (human insulin), which may be dosed just before the meal.<sup>[7]</sup>

The goal of therapy in relation to the previously existing and currently escalating HTN is the reduction of blood pressure to the recommended range. The NICE guidelines for HTN suggests aiming for a target clinical blood pressure below 140/90 mm of Hg in people aged under 80 years with treated HTN. For control of blood pressure people aged under 55 years, the step 1 antihypertensive treatment with an angiotensin-converting enzyme (ACE) inhibitor or a low-cost angiotensin-II receptor blocker (ARB) is

recommended if an ACE inhibitor is not tolerated.<sup>[8]</sup> The patient is being given enalapril, with dosing 600mg BD, which is an angiotensin converting enzyme inhibitor ACEI used in the treatment of HTN. She is also being provided with candesartan, dosing of 8mg OD, which is an angiotensin II receptor antagonist ARB used mainly for the treatment of hypertension. Regular measurements of blood pressure to monitor the response to the antihypertensive treatment coupled with lifestyle modifications and drugs therapy is advised. It is worthwhile mentioning that concomitant prescribing of ACEI and ARB is not recommended.<sup>[8]</sup>

### DISCUSSION

The care plan for DM type II is prepared by using an empirical approach. The NICE guidelines recommend a set of approaches in devising a care plan for the management of the disease. It emphasizes healthy balanced diet that is applicable to the general population when providing advice to people with type II diabetes. Encouragement of high fiber intake and maintain low glycemic index<sup>[4]</sup>. Integration of dietary advice with a personalized diabetes management plan, including other aspects of lifestyle modification, such as increasing physical activity and losing weight i.e. introduction of therapeutic lifestyle changes TLC.<sup>[4,15]</sup> NICE guidelines also recommend the monitoring of serum glucose levels by measuring patient's Hb<sub>A1c</sub> levels at 2–6-monthly intervals tailored to individual needs.<sup>[4]</sup>

The care plan for HTN consists of pharmacological and dietary approaches for effectively managing the disease. The drug therapy should be continued with strict compliance and routine follow up to review improvement in signs and symptoms and to alter regime accordingly. Ascertain people's diet and exercise patterns since a healthy diet coupled with regular exercise can reduce blood pressure. Encouragement of patients to keep their dietary sodium intake low, either by reducing or substituting sodium salt, as this can reduce blood pressure. Lifestyle advice be offered initially and periodically to people undergoing assessment or treatment for HTN.<sup>[8]</sup>

Studies conducted to investigate the relationship between DM and HTN has been performed but none give a definitive association between them. A study with the objective to determine the relation between systolic blood pressure over time and the risk of macrovascular or microvascular complications in patients with type II DM

concluded that in patients with type II DM, the risk of diabetic complications and hyperglycemic episodes was strongly associated with raised blood pressure. Any reduction in blood pressure is likely to reduce the risk of complications.<sup>[10]</sup>

Another study states that the use of antihypertensive drugs for hypertensive patients can also significantly influence the probability, that otherwise healthy individuals will develop metabolic syndrome or type II DM. While diuretics and  $\beta$ -blockers have a pro-diabetic effect, angiotensin-converting enzyme inhibitors ACEIs and angiotensin II receptor blockers ARBs may prevent diabetes more effectively than the metabolically neutral calcium channel blockers.<sup>[11]</sup>

A study investigated HTN and antihypertensive therapy as risk factors for type II DM<sup>[12]</sup> and found out that the risk of DM associated with antihypertensive drug therapy appears to be explained by the presence of HTN alone. Among the subjects who were not taking any antihypertensive medication, the risk of diabetes was much higher among those who had hypertension than among those who did not; however, among the subjects who had hypertension, the risk among those not taking medication was similar to that among those taking one or more agents.<sup>[12]</sup>

Another study which explored the relationship between the resistance to insulin stimulated glucose uptake in patients with HTN.<sup>[13]</sup> The results indicated that the patients with HTN, whether treated or untreated, had significantly elevated plasma glucose and insulin responses to the oral glucose dose, compared to the normal ones.<sup>[13]</sup> Mean serum plasma glucose concentrations were also higher in the patients with either untreated or treated HTN than in the normal patients. These results document the fact that patients with hypertension, whether treated or untreated, are insulin resistant, hyperglycemic, and hyperinsulinemic compared to a well-matched control group.<sup>[13]</sup>

DM is commonly associated with HTN, and an enormous epidemiological data suggest that this association is independent of age and obesity. Much evidence indicates that the link between DM and essential HTN is hyperinsulinemia. Thus, when hypertensive patients, whether obese or of normal body weight, are compared with age and weight matched normotensive control subjects, a augmented plasma insulin response to a glucose challenge is consistently found. A state of cellular resistance to insulin action subtends the observed

hyperinsulinism. With the insulin/glucose-clamp technique, in combination with tracer glucose infusion and indirect calorimetry, it has been demonstrated that the insulin resistance of essential hypertension is located in peripheral tissues i.e. skeletal muscles, is limited to non-oxidative pathways of glucose disposal i.e. glycogen synthesis, and correlates directly with the severity of hypertension. The reasons for the association of insulin resistance and essential hypertension can be sought in at least four general types of mechanisms:  $\text{Na}^+$  retention, sympathetic nervous system hyper activity, disturbed membrane ion transport, and proliferation of vascular smooth muscle cells.<sup>[14]</sup>

Although the case is an apt example of how co morbidity of HTN causes DM type II, The failure of correct prescribing practices leads to the development of a loop hole in the care plan for HTN devised for the patient. Thus the therapy being provided is irrational. The NICE guidelines clearly recommend the use of an ACE inhibitor or an ARB, also discourages the use of both of them together.<sup>[8]</sup> The patient under consideration, is being prescribed with both candesartan which is an ARB, as well as enalapril, the ACEI. In addition to the incorrect prescribing practice, the patient is also being provided with an overdose of the ACE inhibitor. The oral dose of enalapril for treating high blood pressure is 2.5-5mg, The dosage may be titrated upward until blood pressure is controlled or to a maximum of 40 mg daily.<sup>[9]</sup> The patient is being prescribed with a daily dose of 1200mg/day in 600mg given in divided dose twice daily. Such overdosing can precipitate adverse drug reactions and/or clinical toxicity in association with hypotension. This projects the overall health care dilemma of the country where irrational prescribing is a common issue. Proper health care reforms in the system and inclusion of a pharmacist is the need of the hour.

## CONCLUSION

This case report presents an association between type II DM in patients with co morbidity of HTN. There is an association between the levels of plasma glucose concentration previous cardiac complications and blood pressure of non-diabetic individuals. The management of such patient requires adequate drug therapy but in this case the therapy was irrational and had dosing issues. It can be rectified by incorporation a clinical pharmacist in the health care team.

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## Statement of consent

Patient consent was obtained prior to documenting medical information.

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