**Microvascular Complication of Diabetes:**

**Nephropathy**

**Introduction**

Diabetes is a disease associated with both microvascular and macrovascular complications. This paper seeks to expound on nephropathy, a microvascular condition greatly associated with renal failure.

**Pathophysiology of Diabetic Nephropathy**

Diabetic nephropathy is one of the three major microvascular complications caused by diabetes. It is one of the main causes of end-stage renal failure (ESRD). This condition is triggered and will progress due to the interruption of normal haemodynamic and metabolic control. Nephropathy is the most chronic of all diabetes complications. If glycaemic and blood pressure control is achieved, the progression of this condition can be controlled (Gnudi, 2015). In the early onset of the disease, several indicators of endothelial dysfunction can be observed. These include notable changes in microvascular reactivity and the presence of soluble vascular adhesion molecules. The presence of albumin in the urine (albuminuria) and changes in vascular permeability follow after the occurrence of the aforementioned indicators. Diabetic nephropathy has three major events that occur simultaneously, each being the cause of another. These is usually a notable increase in the vascular endothelial growth factor A (VEGF-A); irregular quantities of some growth factors and the consequential enlargement in glomerular capillaries; and a rise in the glomerular vascular penetrability.

It is also during this first stage of the developing renal condition that there is an increase in plasma flow and the glomerular filtration rate. Experiments have shown that an increase in the glomerular capillary pressure has a synergistic effect with the interruptions in metabolism control. Hyperglycaemia and glomerular high blood pressure, therefore, will accelerate the development of diabetic nephropathy (Gnudi, 2015). There is usually the upregulation of angiotensin II which is a receptor blocker, due to the hyperglycaemia. Apart from angiotensin II, transforming growth factor and nitric oxide are also factors to be considered in the development of dysregulations of the glomerular capillaries.

As the disease advances, there are increases in cellular inflammation and extracellular deposits, an irregular angiogenesis, and tissue damage that progresses with time. These reactions are caused by increases in oxidative stress that comes with the progression of the disease. There could be damage to the tubular structure due to the extracellular deposits, as well as fibrosis in the interstitium. Glomerulosclerosis will also occur as a result of the accumulation of deposits in the glomerular compartment.

 Other considerable events can be observed in the filtration boundary; for example, when endothelial cell damage occurs, cells lose the ability to detach and to die normally and also the peri-cellular matrix. The progression of diabetic nephropathy is also associated with the detachment of podocytes, which has been proven to increase albuminuria. The detachment occurs simultaneously with the thickening of the glomerular membrane at the base. The detachment of podocytes is also proven to contribute to the distorted perm-selectivity of the glomerular membranes. Advancement through the stages of albuminuria, from a normal condition, micro albuminuria, macro albuminuria, and then renal failure is caused by the worsening of the conditions of the glomerular and tubular compartments. It is estimated that there is a window of 21 years between the beginning of clinical albuminuria and death.

**Assessment and Diagnosis of Diabetic Nephropathy**

Blood tests are the most commonly used indicators of a probable diabetic condition. Apart from those, other more specific testing methods such as urine tests are employed for diagnosis of nephropathy. It is recommended that a screening be done five years after diagnosis of type 1 diabetes, while it should be done at the time of diagnosis for type 2 diabetes. It is presumed that there is already some microalbuminuria by the time of a type 2 diabetes diagnosis. This is proven to be true in 7% of those diagnosed. If albuminaria is not evident at the time of diagnosis, it is recommended that the tests be done a year later and are repeated every year for both diabetes type 1 and 2.

**Urine Tests**

These are done on a spot sample of urine. The main considerations in these tests are the albumin levels, given in mg/L (milligrams per litre) units. There are other units used to give accurate readings due to the possible errors that could come as a result of changes in the dilution of a patient’s urine. The unit is however considered accurate enough and is an inexpensive test procedure. The European Diabetes Policy Group recommends a cut-off value of 20mg/L (Jorge et al. 2005). All patients with results suggesting the presence of microalbuminuria are subjected to three or more tests due to the variability of urine concentration and albumin excretion.

**Monitoring of Renal Functioning**

The Glomerular Flow Rate (GFR) is known to be the best indicator of renal function. The GFR should be taken in all patients exhibiting microalbuminuria or macroalbuminuria. It is monitored over a 3-month period by a general practitioner and regular values are taken to determine the rate at which it is declining. The decline is given in units of millilitres per minute, per month (ml. min-1. month-1). Without medical assistance, a patient with macroalbuminuria could show a GFR decline rate of 1.2 ml. min-1. month-1. A more rapid GFR decline is an indicator of already-progressed glomerulopathy and high loss of metabolic control. Type 2 diabetes patients generally have a more varying GFR as compared to their type 1 counterparts. If a GFR of 1.73 ml. min-1. month-1 is reached, the patient should see a nephrologist for advice on GFR management.

**Kidney Biopsy**

In the case of a kidney biopsy, the doctor will remove a sample of kidney tissue for close examination. The criteria for this test in a Type 1patient can be considered as when the patient reports proteinuria and a quick drop of renal function especially with no retinopathy detected. Type 2 diabetes patients have less defined criteria for kidney biopsy due to the varying amounts of nondiabetic renal lesions according to nature of the test criteria and the patient’s cultural background (Jorge et al. 2015)

**Imaging Tests**

In the event that there is a pre-existing condition such as a urinary tract obstruction, it is advisable to have an ultrasound. Uterine Artery Embolization is subject to variation and makes urine tests inaccurate if the patient has this condition, kidney stones, or the patient’s family has a history of kidney disease (Jorge et al., 2015).

**Treatment and Management of Diabetic Nephropathy**

There are various treatment options both for early-stage patients and those with advanced nephropathy. The recommended treatment plans for patients in the early stages include medication and proper management through lifestyle changes to improve certain bodily conditions, as discussed below.

**Control of High Blood Pressure**

This is taken as a general management measure as it greatly reduces the chances of diabetes patients developing cardiovascular diseases. It is imperative that diabetes patients maintain a blood pressure level of 130/90, a lower target than those without the disease. It has been proven that the possibility of having a cardiovascular condition lowers by 50% for a diabetes patient who has their diastolic blood pressure reduced from 85 to 81 (Jorge et al., 2015). Renin-angiotensin system blockade (RAS) used in conjunction with ACE inhibitors makes an improvement to deteriorating renal function. The same medication is known to reduce UAE thus helping patients with microalbuminuria to lower the chances of quick advancement to macroalbuminuria. It has also been proven that intensive hypertension control makes the rate of decline of GFR reduce in type 1 diabetes patients.

**Proper Management of Blood Sugar**

It is recommended that diabetic patients have a 7% or lower average haemoglobin AIC (Mayo Clinic, 2016). It has been proven that structural issues related to nephropathy are less likely to occur in people who maintain low levels of blood glucose. Patients who have been subjected to strict hyperglycaemia treatment have been observed to have a 30% decrement in the risk of microalbuminuria (Jorge et al., 2015). It is worth noting that blood sugar control also has an immediate positive effect on reducing the risk of developing hypertension. In patients with microalbuminuria, management of blood sugar levels helps in preventing the progression to macroalbuminuria.

**Lower Cholesterol Levels**

Cholesterol-lowering drugs like lovastatin have been observed to have a positive effect on the reduction of glomerular injury. Improvement using this method can be observed by monitoring protein levels in urine. A reduction in cholesterol levels will translate to lower protein levels in the urine. This can help control albuminuria and boost kidney function.

**Treatment for Advanced Nephropathy**

In the event that a patient has kidney failure as a result of this diabetic complication, health professionals should advise suitable ways to treat kidney function in the body and make the patient comfortable. One of the available options is kidney dialysis. Haemodialysis is common and involves having the patient visit a health centre where they are connected to an artificial kidney machine. The average life expectancy for a patient on dialysis is five to ten years, although there are cases of patients who have lived on dialysis for over 20 years (National Kidney Foundation, 2015). Having a kidney transplant is by far the better alternative for eligible patients. Symptom management without the inclusion of any of the above procedures would give the patient some comfort but they will have a life expectancy of a few months.

**Conclusion**

Nephropathy is a complex complication but one that is manageable, thanks to extensive research and findings done over time as summarised in this paper. It important for healthcare providers and patients to ensure prevention and proper management of nephropathy

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