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REVIEW

A practical approach to chronic kidney disease in primary care

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Abstract

Chronic kidney disease (CKD), a common clinical problem in primary care, can be defined as any abnormality of the kidney structure and/or function that has been present for at least 3 months. Over the past 20 years, the incidence and prevalence of CKD have been increasing in Malaysia in line with the rising number of non-communicable diseases. At present, CKD has no cure. The treatment of CKD is very much dependent on early diagnosis and prevention of CKD progression. In this article, we aim to illustrate a practical approach to CKD in primary care, including diagnosis, evaluation, and management of CKD.

Introduction

Chronic kidney disease (CKD) spans a broad range of disease severity and heterogenicity concerning its risk of clinical progression to end-stage renal disease (ESRD). Long-term complications of CKD include ESRD, complications of ESRD, cardiovascular disease and death.[1] In Malaysia, the incidence and prevalence of CKD and ESRD have risen alarmingly over the past 20 years, which has been partly driven by the rising number of non-communicable diseases, especially diabetes mellitus. Management of CKD is largely dependent on early detection and prevention of disease progression. There is no definite cure for this disease. Because most CKD patients are managed in primary care, we aim to illustrate a practical approach to CKD in a primary care setting in the present article.

Disease Burden of CKD in Malaysia

Globally, CKD prevalence is estimated to be between 10% to 15%.[2,3] An earlier population-based study in 2011 done in Peninsular Malaysia found that 9.1% of Malaysians had CKD.[4] A more recent study that included the Sabah and Sarawak population found that CKD prevalence had increased to 15.5%.[5] Out of this 15.5%, 6.81% had CKD stage 3 to 5. Diabetes mellitus continues to be the leading cause of ESRD in Malaysia, with 69.2% of new ESRD patients in Malaysia in 2018 resulting from diabetic nephropathy.[6] The National Health Morbidity Survey 2019 estimated that 3.9 million Malaysian adults had diabetes mellitus, and 6.4 million Malaysians were hypertensive.[7] It is not surprising, therefore, that the number of patients with CKD is increasing.

Besides mortality and morbidity, CKD also contributes to a significant burden in terms of health care cost. Based on data reported in 2019, the estimated cost of haemodialysis per patient per year was RM39,791, while the cost for peritoneal dialysis reached RM37,576.[8] In total, RM1.12 billion was spent on ESRD in 2016.[9] Given these serious public health impacts, diagnosing CKD early in order to prevent progression to ESRD is therefore essential for primary care practitioners.

1.0 Diagnosis of CKD

1.1 Definition of CKD

CKD can be defined as any abnormality of kidney structure and/or function that has been present for at least 3 months.[10] (**See Table 1.**)

Table 1: Criteria for diagnosis of CKD

Markers of kidney damage (1 or more)	• Albuminuria (AER >30 mg/24 hours; ACR >30 mg/g [>3 mg/mmol]) • Urine sediment abnormalities • Electrolyte and other abnormalities due to tubular disorders • Abnormalities detected by histology • Structural abnormalities detected by imaging • History of kidney transplantation/donation
Decreased GFR	GFR <60 ml/min/1.73 m^2 (GFR categories G3a-G5)
CKD may be diagnosed when either criterion is present for 3 months or more	

*AER: albumin excretion rate, ACR: albumin-to-creatinine ratio

Notably, CKD is not defined solely based on glomerular filtration rate (GFR), as other markers of kidney damage must be taken into consideration. These indications include pathological abnormalities, structural abnormalities or increased urinary albumin excretion. Additionally, the persistence of abnormalities for at least 3 months is necessary to distinguish CKD from acute kidney injury (AKI).[10]

In comparison, ESRD is defined as an irreversible decline in a person's own kidney function, which can be fatal in the absence of renal replacement therapy (RRT). Patients with ESRD are usually dependent on RRT.

1.2 Staging of CKD

The International Kidney Disease: Improving Global Outcomes (KDIGO) guidelines recommend classification of CKD based on cause, GFR category and albuminuria category (**Tables 2 and 3**).[10] Identifying the cause and staging of CKD can help in predicting outcome and guiding disease-specific treatment. The degree of albuminuria has also been shown to portend poorer outcomes in terms of cardiovascular issues, mortality and the kidneys.[11] Together, these factors (cause of CKD, staging and degree of albuminuria) facilitate predicting the prognosis of kidney disease.

Table 2: Staging of CKD based on GFR

GFR category	GFR (ml/min/1.73 m^2)	Term
G1	≥90	Normal or high
G2	60-89	Mildly decreased
G3a	45-59	Mild to moderately decreased
G3b	30-44	Moderately to severely decreased
G4	15-29	Severely decreased
G5	<15	Kidney failure

Table 3: Staging of CKD based on albuminuria

Category	AER (mg/24 hours)	ACR		Terms
		mg/mmol	mg/g	
A1	<30	<3	<30	Normal to mildly increased
A2	30-300	3-30	30-300	Moderately increased*
A3	>300	>30	>300	Severely increased**

*relative to young adult level.**including nephrotic syndrome.

1.3 Screening for CKD

As there is no definite cure for this illness, early detection is vital to help delay the progression of CKD. Population-based screening is currently not recommended.[12] A more targeted approach to screening can be more practical and cost-effective. Specifically, screening should be focused on individuals with risk factors for CKD (**Table 4**).[13] Screening methods include examining serum creatinine (to estimate the GFR) and urine for albumin secretion.

Table 4: Risk factors for CKD that require CKD screening

	Risk factors
Sociodemographic factor	Age > 65 Family history of kidney disease
Comorbid conditions	Diabetes mellitus Hypertension Obesity Gout Metabolic syndrome Cardiovascular disease Autoimmune disease Recurrent urinary tract infection Previous AKI[14]
Structural abnormalities	Structural renal tract abnormalities Benign prostatic hypertrophy Renal calculi
Drugs	Chronic non-steroidal anti-inflammatory drugs Chronic nephrotoxic agents Chronic use of proton pump inhibitor[13]

2.0 Evaluation of CKD

2.1 Clinical Evaluation

Most patients with CKD who are seen in the primary care setting are often in the early stages. Hence, these patients are frequently asymptomatic and typically unaware of their CKD and its seriousness.[14] These factors make it imperative for primary care doctors to identify individuals at risk. Clinical evaluation of these patients starts with a full medical history, a detailed drug and dietary history, the person's history of past blood pressure (BP) and sugar control, and a physical examination. Investigations include renal function test and collecting urine for microscopy and albuminuria.

Some patients may present to the primary care setting with a more advanced stage of CKD. They may have non-specific signs and symptoms of uraemia, such as fatigue, loss of appetite, weight loss, sleep disturbances, and poor concentration.[15] Meanwhile, those who present with acute medical emergencies, such as acute pulmonary oedema, seizures, or uncontrolled hypertension, will need to be referred for hospital care immediately.

After the diagnosis of CKD is confirmed and the cause and stage of the disease have been established (**Table 5**), patients should then be treated and managed according to the stage of CKD. However, unless the patient presents early in the course of CKD, the cause of the CKD may not be confidently ascertained.

Table 5: Approach to CKD

Establish the diagnosis of CKD – persistent kidney damage for >3 months
Stage the CKD by GFR
Look for the cause of CKD
Provide treatment according to stage and cause
Monitor for CKD progression and CKD-related complications
Employ risk stratification and management of cardiovascular risk factors

2.2 Blood test

Serum creatinine is affected by many factors, such as age, gender, muscle mass and protein meals. That said, it is an insensitive marker of GFR early in the course of CKD, as an initial rise in serum creatinine indicates about 50% loss of GFR.[16] Hence, detection of CKD based on estimated GFR is a more accurate assessment of renal function than serum creatinine.[1] A normal GFR is approximately 120 to 130 ml per minute per 1.73 m^2 in young adults, decreasing by an average of 1 ml per minute per 1.73 m^2 per year beginning at the age 30-40 years.[17]

Estimated GFR (eGFR) can be derived from serum creatinine based on several equations (**Table 6**). The more commonly used formulas for GFR estimation in daily practice are the modification of diet in renal disease (MDRD) equation and the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation. The highly recommended CKD-EPI represents the current standard of care, as it provides a more accurate eGFR in a normal individual or in GFR >60 ml/min/1.73 m^2.[18]

The Cockcroft-Gault formula is now used only for adjusting medication dosage.[12] Serum cystatin C based GFR is most beneficial when false positive decreased GFR is suspected.[12] However, this latter test is more expensive than other options and is not widely available.

Table 6: Equation to derive eGFR

Equation for GFR estimation	Variables	Notes	Online calculator
4 variable MDRD	Age, sex, race, and creatinine level	Reasonably accurate in non-hospitalised patients with CKD. Less accurate in normal or obese individuals.	https://qxmd.com/calculate/calculator_140/mdrd-egfr
CKD-EPI	Age, sex, race, and serum creatinine level	More accurate assessment for normal individuals or individuals with mildly reduced GFR.	https://qxmd.com/calculate/calculator_251/egfr-using-ckd-epi
Cockcroft-Gault formula	Age, weight, sex, serum creatinine	Medication dosage adjustment.	https://qxmd.com/calculate/calculator_51/crcl-cockroft-gault
Cystatin C	Age, sex, race, serum cystatin C level	Beneficial when false positive decreased GFR is suspected.	https://www.mdcalc.com/ckd-epi-equations-glomerular-filtration-rate-gfr

A few caveats should be noted when applying these equations for eGFR. The eGFR is not accurate in the setting of AKI, as kidney function is not in a steady state.[1] It is also less accurate in patients with extreme muscle mass, malnutrition, or liver disease.

2.3 Urine examination

Urine examination is performed to detect proteinuria or microscopic haematuria. Proteinuria, which refers to increased excretion of any urinary protein, has both diagnostic and prognostic value in CKD.[17] Persistent proteinuria is often a defining marker of renal injury and a sign of glomerular or tubular disease. Notably, patients with proteinuria may still have normal eGFR. Prognostically, the presence of proteinuria also signifies a higher risk of cardiovascular disease and death.[12] Several methods that are available to evaluate for proteinuria include urine dipstick, automated urinalysis, albumin-to-creatinine ratio (ACR), urine protein-to-creatinine ratio (PCR) and 24-hour urine protein (Table 7).

A urine dipstick analysis is an inexpensive and widely available test. This simple semiquantitative test can be employed in the primary care setting. However, it is important to keep in mind the possibility of false positivity in the event of concentrated urine, gross haematuria or the presence of antibiotics.[19] Apart from false positivity, the urine dipstick test is relatively insensitive to non-albumin protein. Automated urinalysis in this setting will help improve predictive value for significant proteinuria.

Moderately increased albuminuria is defined as a urinary albumin excretion rate of 30-300 mg/day and is often the earliest sign of diabetic kidney disease. Moreover, a urine albumin measurement provides a more sensitive and specific measure of changes in glomerular permeability than total urine protein.[8] A single early morning urine sample for ACR is a sufficiently sensitive test to detect moderately increased albuminuria.[20] In contrast, urine spot PCR also includes tubular secreted proteins, as well as plasma protein from disease processes and infection, making it a less sensitive test.[12] Routine 24-hour urine quantification for protein is both cumbersome and often poorly performed. Hence, the KDIGO guidelines recommend urine ACR as an initial screening test for proteinuria.

Table 7: Different tests that can be used to detect proteinuria or albuminuria

Test	Significant proteinuria
Urine dipstick	Positive when proteinuria >500-1000 mg per day
Automated urinalysis	Positive when proteinuria ≥300 mg per day
Urine albumin-to-creatinine ratio	≥30-300 mg/g – moderately increased albuminuria >300 mg/g – severely increased albuminuria
Urine protein-to-creatinine ratio	>200 mg/g signify presence of proteinuria
24-hour urine protein	≥150 mg/day signify presence of proteinuria >3 g/day signify nephrotic range proteinuria

In addition to tests aimed at identifying proteinuria, urine examination is also used to evaluate microscopic haematuria, which can be caused by structural renal tract disease or glomerular disease. Common causes of microscopic haematuria include urinary tract infection, benign prostatic hyperplasia and urinary calculi.[21] A patient with isolated microscopic haematuria should be evaluated for urological causes of haematuria. The presence of hypertension, elevated creatinine, cellular cast, and proteinuria should prompt a nephrology referral, as these may indicate glomerular disease.[21]

2.4 Ultrasound

All patients with CKD should undergo an ultrasound. This procedure can provide the following information:

a) Renal size, shape and location – small kidney size may suggest chronicity of kidney disease. Renal size assessment is an important consideration prior to renal biopsy. It may detect abnormal anatomy, such as horseshoe kidney.[22]
b) Renal cortex and echogenicity – a thin renal cortex and increased renal echogenicity are signs of CKD.[22]
c) Obstruction – the presence of hydronephrosis and hydroureter is suggestive of renal tract obstruction.
d) Structural pathology – renal calculi and polycystic kidney disease can be diagnosed from an ultrasound.

2.5 Causes of CKD

Once the diagnosis of CKD has been established, the next step is to look for the cause. Causes of CKD can be broadly classified according to their pathophysiological mechanism (**Table 8**). Such mechanisms include pre-renal, renal vascular, glomerular, tubulointerstitial, hereditary and obstructive causes. In the case of pre-renal causes, clinical evaluation may elucidate the patient's history and detect the presence of signs and symptoms of chronic heart failure or chronic liver disease.

The presence of dysmorphic red blood cell cast, proteinuria and haematuria points towards a possible glomerular cause of CKD. If a glomerular disease is suspected, a serologic workup is indicated.[1] A renal biopsy may be needed to establish the underlying glomerular disease since specific treatment may be given depending on the histopathological diagnosis. Those with CKD of uncertain cause may need a nephrologist consult. Meanwhile, obstructive causes of CKD should be referred to urology for intervention.

Table 8: Common causes of CKD

a) Pre-renal causes 1. Cardiorenal syndrome – chronic heart failure may lead to CKD 2. Liver cirrhosis
b) Renal vascular causes 1. Hypertensive nephrosclerosis 2. Renal artery stenosis 3. Vasculitis 4. Renal vein thrombosis
c) Glomerular disease – characterised by proteinuria and haematuria from urine examination 1. Primary glomerular disease • Membranous nephropathy • Ig A nephropathy • Focal segmental glomerulosclerosis • Minimal change disease 2. Secondary glomerular disease • Lupus nephritis • Diabetic nephropathy • Rheumatoid arthritis • Amyloidosis • Light chain deposition disease • Neoplasia
d) Tubulointerstitial disease 1. Drug induced 2. Infection 3. Multiple myeloma cast nephropathy
e) Cystic/hereditary disease 1. Alport syndrome 2. Autosomal dominant polycystic kidney disease 3. Fabry disease
f) Urinary tract obstruction of any causes, such as renal stone disease, benign prostatic hyperplasia, etc.

2.6 Referral to nephrologist

Primary care physicians play a central role in referring patients to nephrologists in a timely manner,[1] especially since a timely referral can facilitate intervention to delay CKD progression and allow time to prepare the patient for RRT. Timely referral has been shown to improve the preparation for RRT, lower the use of a dialysis catheter, reduce emergency dialysis and improve survival (**Table 9**).

Table 9: Indication for nephrology referral

CKD with rapid decline in eGFR >5 ml/min/1.73 m^2 in 1 year or >10 ml/min/1.73 m^2 within 5 years
CKD with heavy proteinuria (urine protein >1 g/day) despite optimal treatment
Persistent unexplained microscopic haematuria and proteinuria (proteinuria >0.5 g/day)
CKD of unknown cause
CKD stage 4 (eGFR<30 ml/min) for preparation of RRT
CKD in pregnancy or when planning for pregnancy
CKD with refractory hypertension
Isolated microscopic haematuria after excluding urological causes
Suspected hereditary cause of CKD (eg, polycystic kidney disease)
Metabolic workup for recurrent renal stones
Persistent abnormalities of serum potassium

3.0 Management of CKD

3.1 General management

The aim of management of CKD are as follows[23]:

a) To delay progression of CKD
b) To reduce cardiovascular risk
c) To reduce further kidney injury, avoidance of nephrotoxic drugs
d) To identify patients who need renal replacement therapy
e) To manage complications of CKD
f) To adjust medications based on GFR

In general, the management of CKD depends on the stages of CKD. Most stage 1-3 CKD patients can be managed in the primary care settings, whereas CKD 4-5 should be managed in the hospital setting. In CKD 1-3, the treatment mainly aims to halt the progression of CKD (**Table 10**).

Table 10: Management of CKD according to stage

Stage	Management plan
Stage 1	Treat comorbid condition, manage cardiovascular risk factors and delay progression of CKD
Stage 2	Delay progression of CKD
Stage 3	Delay progression of CKD and treat CKD complications
Stage 4	Refer to hospital for RRT preparation and treatment of CKD complications
Stage 5	Initiate RRT

3.2 CKD progression

Patients with CKD will inevitably progress. Progression of CKD is defined as a decline in GFR category or a drop in GFR category accompanied by a 25% or greater drop in eGFR from baseline.[10] Patients with CKD 1-3 should have their eGFR regularly monitored 1-2 times/year. A more practical way of assessing CKD progression is to monitor eGFR trajectory, that is, annual change in eGFR or eGFR slope. This practice can encourage primary care physicians to track eGFR changes over time. Patients with risk factors for rapid decline should be identified early, and if the rapid decline is confirmed, they should be referred to a nephrologist's care.

Risk factors for progression of CKD include[24]:

a) Proteinuria
b) Suboptimal BP control
c) Suboptimal glycaemic control
d) Smoking
e) Cardiovascular disease
f) Acute kidney injury
g) Anaemia

3.3 Lifestyle modification

General advice on lifestyle modifications is applicable to all stages of CKD. Lifestyle modifications include smoking cessation, weight reduction, a low-salt diet (<2 g/day) and avoidance of nephrotoxic agents.[13] Patients with CKD should be encouraged to engage in physical activities compatible with cardiovascular health and tolerance (at least 30 minutes, 5 times per week).[10] Smoking is associated with a higher rate of CKD progression.[25] Smoking cessation will reduce the risk of CKD progression as well as cardiovascular risk. Dietary input from a dietitian may help in providing advice regarding a low-salt and low-potassium diet (**Table 11**).

Table 11: Strategies to delay CKD progression

Lifestyle	Physical activity compatible with cardiovascular tolerance (aim for at least 30 minutes, 5 times/week) Smoking cessation Weight reduction
Dietary	Low-salt diets (<2 g/day) Low-protein diet (0.6 g-0.8 g/kg/day)
BP and proteinuria	Target BP for diabetic patient is ≤130/80 mmHg For non-diabetic patient with CKD, the target is - ≤140/90 mmHg if the proteinuria is <1 g/day - ≤130/80 mmHg if the proteinuria is >1 g/day ACEI/ARB is first choice antihypertensive
Glycemic control	Aim for HbA1C of 6.5% to 7.0%
Drug	Avoid nephrotoxic drugs Use of sodium-glucose co-transporter-2 (SGLT2) inhibitors can help delay CKD progression

3.4 Hypertension and proteinuria

BP control and proteinuria reduction are the 2 most important interventions in delaying CKD progression and reducing cardiovascular risk in CKD patients.[20] Specifically, the control of hypertension, which is present in more than 80% of CKD patients, is often suboptimal in these patients.[14]

Many studies and guidelines have advocated for tight BP control for patients with CKD. Additionally, the BP targets are different for those with diabetes mellitus and those without. The target BP for diabetic patients is ≤130/80 mmHg, which has been shown to reduce the risk of CKD progression. This finding is supported by the RENAAL study revealing that patients who achieved a systolic BP <130 mmHg had a significantly lower risk of ESRD or mortality[26] and further supported by the ADVANCE-ON trial where mortality benefits were observed in diabetic patients treated with BP-lowering therapy.[27] For non-diabetic patients with CKD, the target is ≤140/90 mmHg if the patient's proteinuria is less than 1 g per day and ≤130/80 mmHg when proteinuria is more than 1 g per day.[13]

Any antihypertensive can be used to control BP in patients with CKD. The most critical issue in prescribing antihypertensive medications is probably medication adherence.[28] A renin-angiotensin system (RAS) blockade by way of angiotensin-converting enzyme inhibitor (ACEI) or angiotensin II receptor blocker (ARB) is the preferred first-line option for those with diabetic kidney disease or those with heavy proteinuria (proteinuria >1 g per day).[13] RAS blockade has been demonstrated to reduce proteinuria and has the effect of slowing the progression of CKD independent of BP control.[23] This outcome is supported by the RENAAL study and IDNT study. Note that monitoring the renal profile and serum potassium within 2-4 weeks after initiation of ACEI or ARB or within 2 weeks of an increase in dosage is vital. Moreover, combining ACEi and ARB is not recommended, as complications are more common without clear benefits.1

3.5 Glycaemic control

The current glycaemic control target is an HbA1C of 6.5% to 7.0%.[1,10,13] Maintaining an optimal HbA1c reduces cardiovascular risk as well as the development of albuminuria and loss of renal function over time.[1] The benefits of strict diabetic control must be weighed against the risk of hypoglycaemia, especially in the older adults and in patients with more advanced CKD. Medications should be reviewed regularly, and dosage may need to be adjusted according to the eGFR, especially in the use of sulphonylurea (hypoglycaemia) and metformin (lactic acidosis).

Recently, SGLT2 inhibitors have been found to have a renal protective effect. The 2019 CREDENCE trial demonstrated that treatment with canagliflozin for patients with type 2 diabetes and albuminuric CKD stage 1-3 (median eGFR 56 ml/min) was associated with a reduced risk of ESRD, reduced progression of CKD and a lower risk of cardiovascular events.[25] The DAPA-CKD trial also confirmed the benefits of SGLT2 inhibitors in CKD patients (median eGFR 43 ml/min) regardless of the presence or absence of diabetes. In this trial, the use of dapagliflozin was shown to delay the progression of CKD and reduce the risk of ESRD as well as the risk of death from renal or cardiovascular causes.[29] Similarly, in the

EMPA-REG study, the use of empagliflozin also improved the cardiovascular outcome of diabetic patients with CKD (median eGFR 70-80 ml/min).[30] Regardless of eGFR, SLGT2 inhibitors have consistently shown benefits in patients with CKD across all trials.

3.6 Dyslipidaemia

Dyslipidaemia is a major risk factor for a cardiovascular event. All patients with newly diagnosed CKD should have a lipid profile evaluation. In adults aged >50 years with CKD not on RRT, treatment with lipid-lowering therapy is recommended. This suggestion is supported by the SHARP trial, in which statin plus ezetimibe therapy led to a significant 17% reduction in the relative hazard of the primary outcome involving a major atherosclerotic event. In adults aged 18-49 years with CKD not on RRT, lipid-lowering therapy is recommended if the patient has 1 of the following conditions: known coronary artery disease, diabetes mellitus, prior ischaemic stroke or 10-year risk of cardiovascular event >10%.[31]

3.7 Risk for AKI and infection

Patients with CKD are at higher risk of developing AKI and infection. Any episode of AKI will further reduce the number of viable nephrons and accelerate the progression of CKD. Infection and nephrotoxic medications are the risk factors for AKI.[25] A key consideration includes the identification of a patient at risk of AKI (hypovolemia, sepsis), good management of medication, immunisation and monitoring of GFR.[20] Withholding metformin, SGLT2 inhibitors, or ACEi/ARB is recommended in the event that the patient is at risk of dehydration or hypovolaemic, for example, experiencing diarrhoea or vomiting, especially if the patient requires hospital admission.23 Unless contraindicated, patients with CKD should be offered an annual influenza vaccination.

4.0 Management of complications of CKD

4.1 Anaemia

Anaemia is defined as a haemoglobin level of <13 g/dl in men and <12 g/dl in women.[10] As CKD progresses, patients are at increased risk of developing anaemia, as erythropoietin production decreases with a low GFR. It is recommended that patients with stage 3 CKD should have their haemoglobin level measured at least annually or even more frequently as renal function declines. Anaemia usually starts to develop when GFR <60 ml/min/1.73 m^2. The treatment of anaemia in CKD includes iron supplementation, use of an erythropoietin-stimulating agent (ESA) and blood transfusion. All CKD patients with iron deficiency should be treated with iron supplementation. Once iron deficiency has been corrected, the use of an ESA can be considered after discussion with a nephrologist. The optimal Hb target in CKD is 10-12 g/dl.

4.2 Mineral bone disease

CKD-mineral and bone disorder (CKD-MBD) is a common complication of CKD. Patients with CKD stage 3 and above should at least have serum calcium, phosphate, alkaline phosphatase, and parathyroid hormone (PTH) measured annually – or more frequently if any abnormalities. The principle of treatment for CKD-MBD is phosphate level reduction towards a normal level.[10] Initial treatment starts with dietary phosphate restriction when phosphate and PTH levels begin to rise. Dietary phosphate restriction also involves a low-protein diet. Patients who can comply with a low-protein diet will usually exhibit a lower phosphate level.[32] Drug therapy with phosphate binders should be considered if a patient demonstrates persistent hyperphosphatemia despite dietary restriction. Excess calcium supplementation and a vitamin D analogue should be avoided, as this combination may increase the risk of vascular calcification.

4.3 Fluid overload

The progression of CKD puts patients at risk of developing fluid overload, mainly due to reduced urine production. Accordingly, assessing the fluid status in the clinic setting is essential, looking for symptoms and signs of fluid overload such as uncontrolled BP, raised jugular venous pressure, crepitations in the lungs and pedal oedema. Patients exhibiting fluid overload may be treated with fluid and salt restriction and loop diuretics.[1]

4.4 Cardiovascular risk

Low GFR, proteinuria, and CKD-MBD with vascular calcifications have all been associated with cardiovascular morbidity and mortality.[33] Management of cardiovascular risk in patients with CKD is similar to that for those without CKD, involving BP control, glycaemic control and lipid-lowering therapy. Antiplatelet therapy should be offered only as

secondary prevention due to an increased risk of bleeding in this group of patients.[20]

4.5 Metabolic acidosis

Metabolic acidosis is a complication of CKD that can be present from stages 3 to 5 and needs attention from primary care physicians. Treatment of CKD-related metabolic acidosis with oral alkali has been shown to delay CKD progression. For example, sodium bicarbonate can be initiated when the patient's serum bicarbonate level is less than 22 mmol/L.[1,34]

Conclusion

In conclusion, CKD is a common clinical problem in primary care practice whose prevalence is likely to increase in line with the ageing population and the growing number of risk factors associated with CKD. This disease is often asymptomatic in its early stage. Primary care practitioners play an essential role in identifying and screening those patients at risk, establishing the cause(s) of CKD, and managing those patients in the early stages of CKD accordingly. Referral to a nephrologist may be necessary to identify the primary cause of the CKD for specific treatment. Those with more advanced CKD should be referred for tertiary care in a timely manner to slow the progression towards ESRD and prepare the patient for long-term RRT.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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