Cardiovascular manifestations in patients with chronic renal failure

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Introduction

Our hearts and kidneys are two intrinsically linked organs. To better understand their relationship and how damage to one affects the other, we will start at one extreme: chronic renal failure (CKD). We as clinicians are only able to delay the evolution to end-stage kidney disease (ESKD), which is affected by various geographical, racial, and age-related factors [1].

The idea that there is an increased risk of cardiovascular disease at every stage of chronic kidney disease is well-established, with sufferers twenty times more like to die of a heart attack or stroke than to receive dialysis. Even after receiving renal replacement treatment, cardiovascular problems are the leading cause of death in CKD patients (the Centre of Disease Control notes heart disease as the leading cause of death in the United States outright) [1,2,3]. Indeed, in earlier stages of CKD, the cardiovascular risk is much higher than that of renal failure, with the patient more like to succumb to cardiovascular disease than ESKD. The likelihood of kidney failure only exceeds that of CVD when there is significant kidney dysfunction (GFR <30 mL/min/1.73 m2) [4].

The existence of a symbiotic relationship between CKD and CVD is well-documented, with CKD promoting hypertension, dyslipidaemia, diabetes, and obesity (the traditional cardiac risk factor square) which then go on to further CKD. To simplify this interrelationship, CKD is an independent risk factor for CVD and vice versa. Each contributes to the pathogenesis of the other, leading to a cycle of progression [5,6,7,8].

Diabetes is regarded as the leading cause of kidney failure in developed countries. Hyperglycaemia damages the arteries in your kidney and causes a higher chance of the patient developing high blood pressure, inflicting further damage. Waste products accumulate in the blood, the kidneys fail, and renal replacement therapy will be needed [9,10].

Aims

The objectives of the present study were to examine cardiovascular symptoms and disease in a group of patients diagnosed with chronic renal failure. Our intention was to explore the associations between the myriad of cardiac pathology and chronic kidney disease.

Materials and Method

The study took place in the Constanta hospital (Romania) with patient records taken from the months of May 2018 (23 patients) and February 2019 (27 patients), so that our data would not be skewed due to any seasonal changes. This makes our work an observational, retrospective, cohort study of non-selected patients. The details of the age interval and numbers are given in Figure 1 and Table 1.

50 patients were methodically selected from the Hippocrates system found on hospital computers, by specifying the above timeframe and searching for the coded phrase, "alta insuficienta renala cronica." Deceased patients were excluded from the survey. None of our patients were found to be undergoing dialysis treatment. Via the EPR (electronic patient record), we were able to systematically analyse.

Statistical analysis was performed using Microsoft Excel 2016 and MedCalc.

Results and Observations

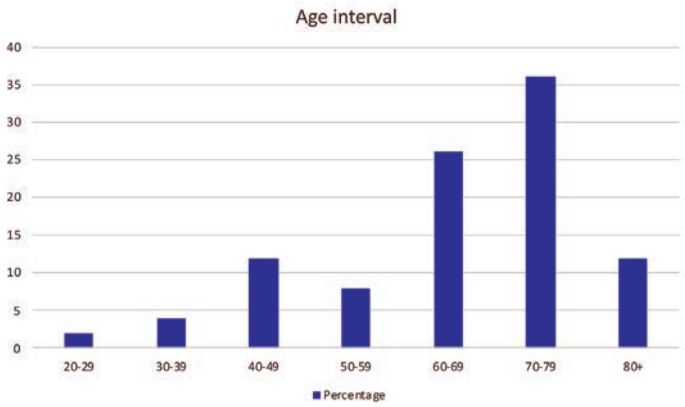

Figure 1: Age Interval

Table: Details of Age Interval

Age Range	Number	Percentage
20-29	1	2
30-39	2	4
40-49	6	12
50-59	4	8
60-69	13	26
70-79	18	36
80+	6	12

From the data we have collected, we can deduce that the 70-79 years age range contained the most CKD sufferers, followed by patients aged between 60-69 years. This lends weight to the theory that CKD is mostly found at an old age population and could be linked to natural ageing phenomenon (as incidence seemingly rises proportional to age). High mortality could explain why the 80+ years age percentile does not have the highest number of patients. This also lends some credibility to the idea that as most patients are asymptomatic sufferers

of CKD, they are only diagnosed with renal failure after developing another co-morbidity in senior populations .

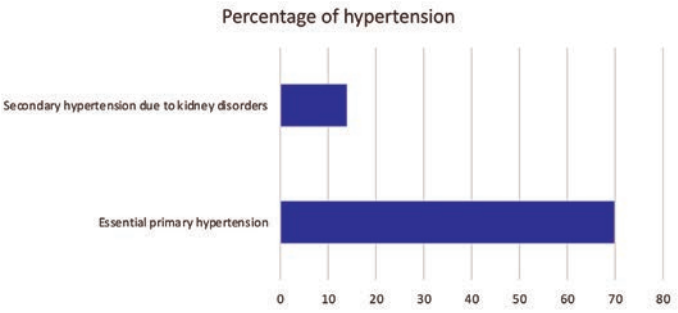

Figure 2: Types and Percentage of Hypertension

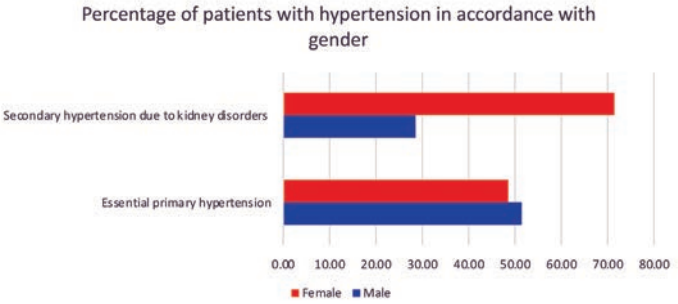

Figure 3: Hypertension & CKD

Table 2: Essential Hypertension and gender

Gender – Essential #1 Hypertension	Number	Percent
Male	18	51.43
Female	17	48.57
Total	35	70

Table 3: Hypertension and CKD (Gender distribution)

Gender - #2 hypertension due to kidney disorders	Number	Percent
Male	2	28.57
Female	5	71.43
Total	7	14

From the total number of patients, 35 (70%) had essential hypertension, either prior or post-diagnosis of CKD (Fig 2). We can class this as a majority, there is a clear association between CRF and hypertension and the synergistic involvement they have with each other's pathology. Male patients were more likely to suffer from essential primary hypertension (Table 2); however, the opposite is true and with a wider comparison for secondary hypertension directly sourced to specific kidney disorders; 71% of females compared to 28% of males (Table 3).

Most hypertensives were known to have grade 3 hypertension (severe), which reveals to us a chronic renal failure's link to worsening hypertension (as there was no hypertensive patient recorded as being in Stage 1). We can also surmise the poor management and control of hypertension in chronic renal failure sufferers. As will be revealed further in this study, most of the cohort were in the final stage of renal failure so this is not a surprising finding. If the patient was hypertensive before the diagnosis of CKD, we could also conclude the former lends itself to earlier deterioration of the renal system.

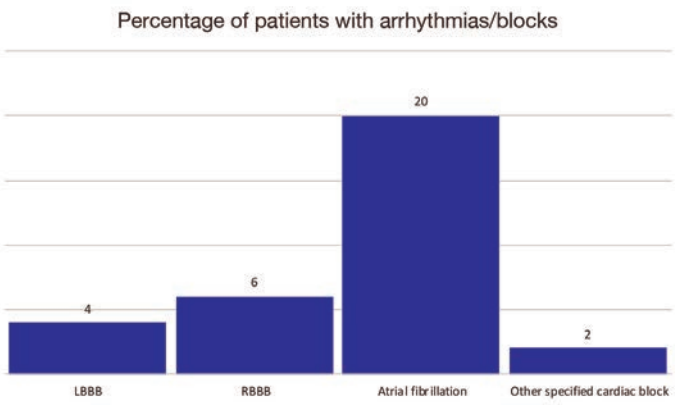

Figure 4: Conduction disorders and arrhythmias

Table 4: Types of Arrhythmias

Characteristic	Number	Percentage
LBBB	2	4
RBBB	3	6
Atrial fibrillation	10	20
Other specified cardiac block	1	2

From the total number of patients collected, 16 (32%) were known to have a conduction defect and/or abnormal rhythm (Fig 4). Of these, atrial fibrillation was the most common and right bundle branch block (RBBB) was more prevalent over left bundle branch block (LBBB), signifying that its finding is of a higher importance and relevance in a renal patient (Table 4).

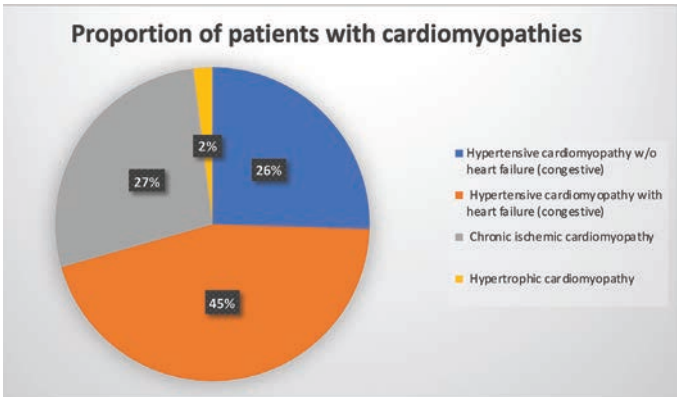

Figure 5: Heart failure and cardiomyopathies

Table 5: Hypertension and Cardiomyopathies.

Cardiomyopathy	Number	Percentage
Hypertensive without congestive Heart Failure	13	26
Hypertensive with congestive Heart Failure	23	45
Chronic ischemic	14	27
Hypertrophic	1	2

A great number of CKD patients in the study presented with a cardiomyopathy, with an overlap noted in various cases (Table 5). Hypertensive cardiomyopathy was especially statistically significantly with 71% of renal patients in our survey suffering from the ailment (Fig 5). Within this subtype, patients were more likely to exhibit congestive heart failure than not (45% compared to 26%). There is an extremely high chance of a patient developing one or more cardiomyopathy if they suffer from CKD, and even more so if they are hypertensive. Almost half of the patients with the most common form of cardiomyopathy were said to also have heart failure (Table 5).

Discussion

Chronic kidney disease (CKD) affects 10–15% of the population worldwide and its prevalence is increasing [11]. CKD is defined as the presence of reduced kidney function (an estimated glomerular filtration rate [eGFR]<60 mL/min/1.73 m2) [12] or kidney damage (often indicated by the presence of proteinuria) for ≥3 months duration [13].

In our study 70-79 (36%) years age range contained the most CKD sufferers, followed by patients aged between 60-69 years (26%). Incidence of CRF is seemingly proportional to increasing age, adding weight to the theory that chronic kidney disease is a factor implicated in normal ageing phenomenon. The high level of mortality in 80+ years old patients explain the percentage drop in that percentile.

A vast majority of patients surveyed (70%) had essential hypertension, signifying a clear link between hypertension and CKD. Male patients were slightly more likely to suffer from essential primary hypertension (51% compared to 48% of females) and female patients were more likely to have secondary hypertension directly sourced to specific kidney disorders (71% of females compared to 28% of males). 69% of high blood pressure patients were graded as being in Stage 3 hypertension, 31% in Stage 2 and none in Stage 1; inferring the severity of CKD's effect on blood pressure and vice versa. The number of patients in Stage 3 leads us to conclude that hypertension is poorly managed in the CKD population. Hypertension is an important risk factor for CKD, and approximately 85–90% of patients with stage 3–5 CKD have hypertension. Long-term hypertension leads to high intraglomerular pressure, which subsequently impairs glomerular filtration [14]. Hypertensive cardiomyopathy was statistically significantly with 71% of renal patients in our survey suffering from the ailment (of which the variety with congestive heart failure is more widespread). There is an extremely high chance of a patient developing one or more cardiomyopathy if they suffer from chronic renal failure, and even more so if they are hypertensive. Almost half of the patients with the most common form of cardiomyopathy were said to also have heart failure. When it comes to diabetes, 40% of patients were known to have type 2 Diabetes Mellitus. Men were more prone to the disease than women. The global prevalence of microvascular and macrovascular complications associated with Diabetes Mellitus is increasing dramatically [15]. Microvascular changes within the kidney often lead to chronic kidney disease (CKD), an entity referred as diabetic kidney disease (DKD) or diabetic nephropathy [16]. This disease is characterised by a distinct histopathological pattern of glomerular basement membrane (GBM) thickening, mesangial matrix expansion, nodular glomerulosclerosis, and arteriolar hyalinosis. This histopathological pattern is frequently observed in young and lean patients with type 1 Diabetes Mellitus (T1DM), but biopsy samples from patients with type 2 Diabetes Mellitus (T2DM), often indicate the presence of other pathogenic factors, such as primary glomerulopathies, ageing-related nephropathy, or previous episodes of acute kidney injury (AKI). Thus, the term DKD lacks precision in describing the most prevalent form of kidney disease in patients with Diabetes Mellitus.

There were 16 (32%) known cases of a conduction defect and/or abnormal rhythm. Of these, atrial fibrillation was the most common and right bundle branch block (RBBB) was more prevalent over left bundle branch block (LBBB), signifying that its finding is of a higher importance and relevance in a renal patient.

Conclusion

We conclude from our study that most patients are asymptomatic sufferers of CKD. They are only diagnosed with renal failure after developing another co-morbidity in senior population.

If the patient was hypertensive before the diagnosis of CKD, we could also conclude the former lends itself to earlier deterioration of the renal system. There is an extremely high chance of a patient developing one or more cardiomyopathy if they suffer from CKD, and even more so if they are hypertensive.

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