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Prevalence of Cardiovascular Autonomic Neuropathy among Patients with End Stage Renal Disease (ESRD) On Hemodialysis in King Khalid Hospital, Najran (KKH-N)

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Abstract

Autonomic dysfunction is a common and potentially life-threatening complication of chronic kidney disease (CKD), and can occur in the absence of length-dependent uremic neuropathy. It may affect various body systems including cardiovascular, gastrointestinal, genitourinary and other body systems leading to significant morbidity.

Cardiovascular autonomic dysfunction in CKD is associated with an increased risk of cardiac arrhythmia and sudden cardiac death. In addition to a potential role in sudden cardiac death, reduced bar reflex sensitivity can also contribute to intradialytic hypotension, a condition occurring during dialysis that is characterized by an abrupt reduction in blood pressure without a compensatory increase in heart rate.

Beside comprehensive history and physical examination, Ewing's five standard cardiovascular reflex tests were used for the assessment of autonomic function.

After analysis the result, the majority of patients with ESRD on Hemodialysis has evidence of cardiovascular autonomic dysfunction. Significantly more patients has evidence of cardiovascular sympathetic dysfunction (82 %) than patients with evidence of cardiovascular parasympathetic dysfunction (56 %) (P < 0.05).

Further work is needed to determine risk factors for development of autonomic dysfunction and measures to reduce it in this patient group.

Introduction

Autonomic neuropathy is a group of symptoms that occur when there is damage to the nerves that manage every day body functions such as blood pressure, heart rate, sweating, bowel and bladder emptying, and digestion[2].

Autonomic dysfunction is a common and potentially life-threatening complication of CKD, and can occur in the absence of length-dependent uremic neuropathy. It may affect various body systems including cardiovascular, gastrointestinal, genitourinary and other body systems leading to significant morbidity. Cardiovascular autonomic dysfunction in CKD is associated with an increased risk of cardiac arrhythmia and sudden cardiac death. In addition to a potential role in sudden cardiac death, Assessment of autonomic function has demonstrated abnormalities in 60% of patients with CKD, particularly relating to measures of parasympathetic function, such as heart rate response to deep breathing, induced hypotension, and the Valsalva maneuver.[1]

Cardiovascular Autonomic

Neuropathy (CVAN) usually is diagnosed a battery of bedside test, that test for sympathetic and parasympathetic function. Ewing et al [2] suggested 5 simple bedside tests for diagnosis of CVAN.

Objective

The objective of this study is to determine the prevalence of cardiovascular autonomic neuropathy (CVAN) among patients with ESRD on regular Hemodialysis in Artificial Kidney Unit (AKU) in King Khalid Hospital, Najran-KSA.

Study Design

Clinical interventional prospective cohort study

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Subjects

- The study included 50 patients, constituting all patient with ESRD on regular Hemodialysis in AKU in KKHN in the period between November 2016 to January 2017.
- Cases with active cardiovascular disease, those with neurological disorders and those on medications that affect the autonomic nervous system were excluded.

Ethical consideration:

- Ethical approval from research committee in King Khalid Hospital- Najran-KSA.
- All patients given their written informed consent.

Method

All subjects were subjected to the following:

- History including: Demorphic data (age, sex), Duration of CKD.,Co- morbidities and Medications
- Physical exams include

General clinical examination:

Special clinical exams related to the study, include 5 tests recommended by Ewing el al 2:

1) Tests reflecting cardiac parasympathetic damage[2]:

- Heart-rate response to Valsalva maneuver: During the strain period of the Valsalva maneuver the blood pressure drops and the heart rate rises.After release the blood pressure rises, overshooting its resting value and the heart slows.
- Heart-rate (R-R interval) variation during deep breathing: Normally the heart rate varies continually but this depends on an intact parasympathetic nerve supply. The variation is abolished with atropine but uninfluenced by propranolol and is more pronounced at slow heart rates, during deep breathing, and in younger patients.
- Immediate heart-rate response to standing: During the change from lying to standing a characteristic immediate rapid increase in heart rate occurs which is maximal at about the 15th beat after standing.

2) Tests reflecting sympathetic damage[2]:

- Blood-pressure response to standing: On standing pooling of blood in the legs causes a fall in blood pressure, which is normally rapidly corrected by peripheral vasoconstriction.3 In patients with autonomic damage the blood pressure falls on standing and remains lower than in the lying position.The test is performed by measuring the patient's blood pressure with a sphygmomanometer while he is lying down quietly and again when he stands up. The postural fall in blood pressure is taken as the difference between the systolic blood pressure lying and the systolic blood pressure standing.
- Blood-pressure response to sustained handgrip: During sustained handgrip a sharp rise in blood pressure occurs, due to a heart-rate-dependent increase in cardiac output with unchanged peripheral vascular resistance.
- Should the normal reflex pathways be damaged, as in diabetics with extensive peripheral sympathetic abnormalities, the rise in blood pressure is abnormally small.

Table 1: Normal, borderline, and abnormal values in tests of cardiovascular autonomic function[3]:

	Normal	Borderline	Abnormal
Tests reflecting parasympathetic function			
Heart-rate response to Valsalva manoeuvre (Valsalva ratio)	⩾1·21	1·11-1·20	⩽1·10
Heart-rate (R-R interval) variation during deep breathing (maximum-minimum heart rate)	⩾15 beats/min	11–14 beats/min	⩽10 beats/min
Immediate heart-rate response to standing (30:15 ratio)	⩾1·04	1·01-1·03	⩽1·00
Tests reflecting sympathetic function			
Blood-pressure response to standing (fall in systolic blood pressure)	⩽10 mm Hg	11–29 mm Hg	⩾30 mm Hg
Blood-pressure response to sustained handgrip (increase in diastolic blood pressure)	⩾16 mm Hg	11–15 mm Hg	⩽10 mm Hg

Data Analysis

- The data was be analyzed by Master Sheet Program which is a software program Statistical Package for Social Sciences (SPSS).

Results

Tests reflecting cardiac parasympathetic damage:

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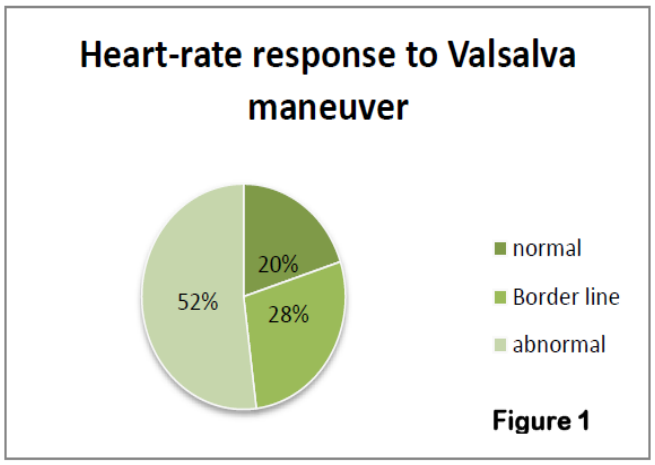
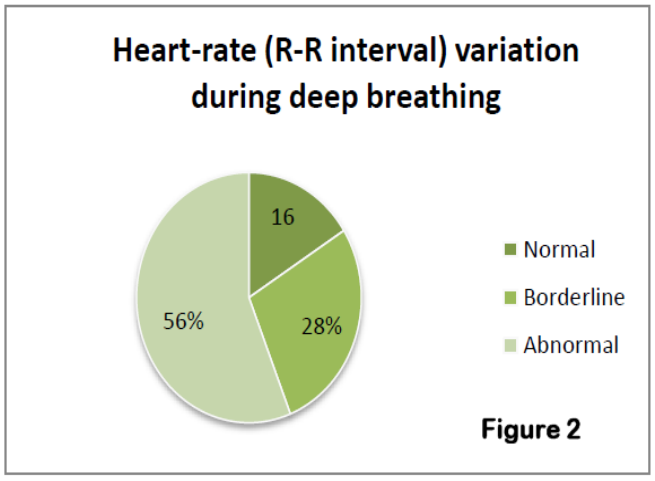


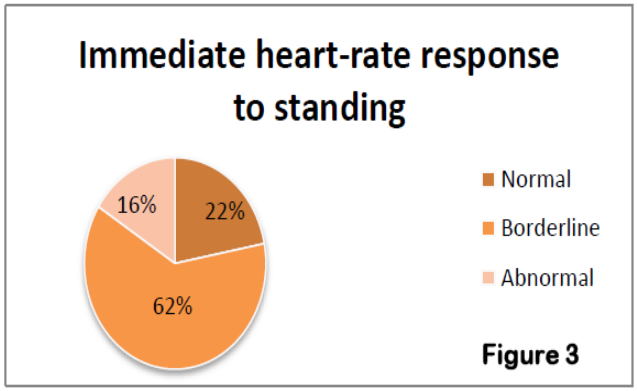
Heart-rate response to Valsalva maneuver:

- 26 patients (52 %) had abnormal response, 14 patients (28%) had border line response while only 10 (20%) patients had normal response. (Figure 1)



Heart-rate (R-R interval) variation during deep breathing:

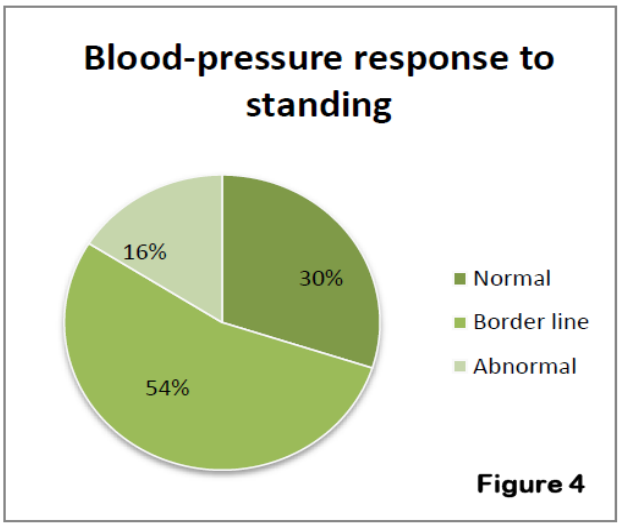
- 28 patients (56 %) had abnormal response, 14 patients (28%) had border line response while only 8 (16%) patients had normal response. (Figure 2)



Immediate heart-rate response to standing:

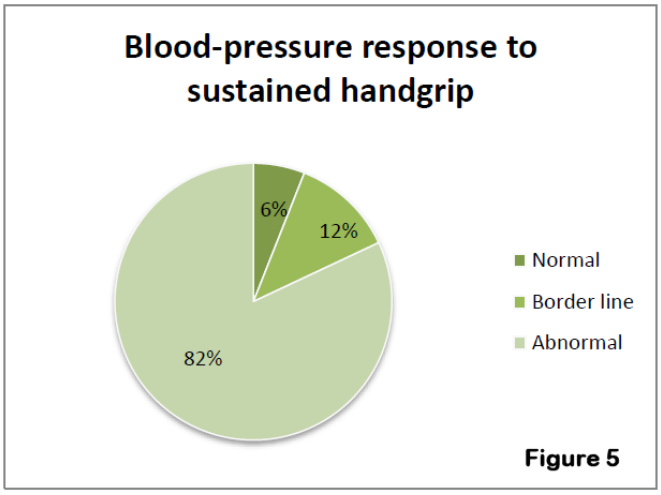
- 8 patients (16 %) had abnormal response, 31 patients (62%) had border line response while only 11(22%) patients had normal response. (Figure 3)

Tests reflecting sympathetic damage



Blood-pressure response to standing:

- 8 patients (16 %) had abnormal response, 27 patients (54 %) had border line response while only 15 (30%) patients had normal response. (Figure4)



Blood-pressure response to sustained handgrip:

- 41 patients (82 %) had abnormal response, 6 patients (12 %) had border line response while only 3 (6%) patients had normal response. (Figure 5)

Discussion

Only three studies were found that objectively evaluated autonomic function among patients with kidney disease. These studies had between 42 and 123 subjects and between 21 and 67 patients with decreased kidney function not yet on dialysis. Each of these studies noted that autonomic function was impaired in more than 50% of patients with chronic kidney disease; however, only one of them found an association between level of kidney function and measures of autonomic nerve function. The results of these studies cannot be extrapolated with confidence to the general population of patients with chronic kidney disease, as two were limited to patients with diabetes and thus confounded

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by the neuropathy ascribable to diabetes, and the third only had patients with very decreased kidney function (GFR <8 mL/min) or on dialysis.[4]

In our study the prevalence of cardiovascular sympathetic dysfunction (82 %) more than patients with evidence of cardiovascular parasympathetic dysfunction (56 %) ($P < 0.05$) which match the result of other studies.

Conclusion

The majority of patients with ESRD on Hemodialysis has evidence of cardiovascular autonomic dysfunction. Significantly more patients has evidence of cardiovascular sympathetic dysfunction (82 %) than patients with evidence of cardiovascular parasympathetic dysfunction (56 %) ($p < 0.05$).Further work is needed to determine risk factors for development of autonomic dysfunction and measures to reduce it in this patient group.

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