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Ambulatory Blood Pressure Monitoring For Hypertension in Pediatric Hemodialysis Patients

Thesis
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بسم الله الرحمن الرحيم

قُلْ إِنَّنِي هَدَانِي رَبِّي إِلَى صِرَاطٍ مُسْتَقِيمٍ دِينًا قِيَمًا مِلَّةَ إِبْرَاهِيمَ حَنِيفًا وَمَا كَانَ مِنَ الْمُشْرِكِينَ (١٦١) قُلْ إِنَّ صَلَاتِي وَنُسُكِي وَمَحْيَايَ وَمَمَاتِي لِلَّهِ رَبِّ الْعَالَمِينَ (١٦٢) لَا شَرِيكَ لَهُ وَبِذَلِكَ أُمِرْتُ وَأَنَا أَوَّلُ الْمُسْلِمِينَ (١٦٣)

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Sara Abu el-enein

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List of Abbreviations

Abb.	Full term
ABPM	Ambulatory blood pressure monitoring
ACE	Angiotensin Converting enzyme
ACR	Albumin – creatinine ratio
AHA	American Heart Association
AKI	Acute kidney injury
ARBs	Angiotensin II receptor blockers
BP	Blood pressure
CAKUT	Congenital anomalies of the kidney and urinary tract
CAPD	Continuous ambulatory peritoneal dialysis
CBP	Clinic blood pressure measurements
CCPD	Continuous cycling peritoneal dialysis
CKD	Chronic kidney disease
CT	Computed tomography
CVD	Cardiovascular disease
DBP	Diastolic Blood Pressure
DW	Dry Weight
ECW	Extra Cellular Water
EPO	Recombinant human erythropoietin
ESC	European Society of Cardiology
ESCAPE	Effect of Strict Blood Pressure Control and ACE-Inhibition on Progression of Chronic Renal Failure in Pediatric Patients
ESH	European Society of Hypertension
ESRD	End-stage renal disease
GFR	Glomerular Filtration Rate
GH	Growth hormone
HBP	Home blood pressure measurements
HD	Hemodialysis
HTN	Hypertension
ICH	International Conference on Harmonisation

List of Abbreviations (Cont…)

Abb.	Full term
IgA	Immunoglobulin A
J-MORE	Jichi Morning Hypertension Research
JNC-7	Joint National Committee-7
KDIGO	Kidney Disease Improving Global Outcomes
KDOQI	Kidney Disease Outcome Quality Initiative
LVH	Left ventricular hypertrophy
LVMI	Left ventricular mass index
MAP	Mean Arterial Pressure
MDRD	Modification of Diet in Renal Disease
MRI	Magnetic resonance imaging
NAPRTCS	North American Pediatric Renal Trials and Collaborative Studies
NICE	National Institute for health and Care Excellance
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases
NIH	National Institutes of Health
NKF	National Kidney Foundation
PARADE	Proteinuria, albuminuria, risk, assessment, detection, elimination
PD	Peritoneal dialysis
PKD	Polycystic kidney disease
RAS	Renin Angiotensin System
RRT	Renal replacement therapy
SBP	Systolic Blood Pressure
SMR	Standardized Mortality Rate
USRDS	United States Renal data System
WCH	White-coat HTN

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Introduction

Cardiovascular disease is the major cause of morbidity and mortality in patients with chronic kidney disease (CKD) Stage 5 and accounts for approximately 50% of deaths ***(Rocco et al, 2002).***

The cardiovascular risk factors among patients with CKD Stage 5 may be divided into those that are nonspecific to kidney disease but are more prevalent, and those that are specific to CKD Stage 5. The latter are undoubtedly important, since patients with CKD Stage 5 have disease-related risk factors such as anemia, hyper-homocysteinemia, hyperparathyroidism, oxidative stress, hypoalbuminemia, and chronic inflammation and prothrombotic factors. In addition, data suggest that uremic factors or factors related to renal replacement therapy (RRT)/dialysis may be implicated in the pathogenesis of heart disease in patients treated by dialysis, because cardiovascular survival improves after transplantation even in high-risk patients ***(K/DOQI guidelines, 2005).***

In addition, patients on dialysis there is also increased prevalence of many traditional factors for cardiovascular risk (age, male gender, hypertension, diabetes, dyslipidemia, and physical inactivity); among these, hypertension is the most important risk factor for the development of cardio and cerebrovascular complications and the leading cause of morbidity and mortality in dialysis patients. However, despite the universally recognized detrimental effect of hypertension in dialysis patients, 60–70 % of patients reported on clinical studies performed in Europe as well as in North America

remains hypertensive while undergoing hemodialysis (HD) ***(Grekas et al, 2001).***

The relationship between hypertension (HTN) and CKD is cyclic in nature. Uncontrolled HTN is a risk factor for developing CKD, is associated with a more rapid progression of CKD, and is the second leading cause of ESRD in the United States (U.S) ***(Botdorf et al, 2011; Segura et al, 2011).***

Meanwhile, progressive renal disease can exacerbate uncontrolled HTN due to volume expansion and increased systemic vascular resistance. Multiple guidelines discuss the importance of lowering blood pressure (BP) to slow the progression of renal disease and reduce cardiovascular morbidity and mortality ***(Chobanian et al, 2003; American Diabetes Association, 2012).***

The main cause of such a poor control has been identified as the difficulty in obtaining optimal dry weight, coupled with large inter-dialytic weight gain and unrestricted, often excessive dietary sodium intake ***(Locatelli et al, 2004).***

Elevated BP is frequent also in children on long-term dialysis therapy. However, the prevalence of hypertension and status of BP control in these patients are lacking. Uncontrolled hypertension was defined as BP equal to or greater than age, sex, and height-specific 95^{th} percentiles; controlled hypertension was considered in children who were administered antihypertensive medications, but had BP less than the 95^{th} percentile. Normotensive children at baseline had significant BP increases, whereas hypertensive children at baseline had significant BP decreases during the first year of dialysis therapy. BP did not change significantly after 1 year of dialysis

therapy; 51% of patients had uncontrolled hypertension after 1 year of maintenance dialysis therapy. Logistic regression analysis shows that baseline hypertensive status and use of BP medications are both large significant risk factors for subsequent hypertension. Other risk factors include young age, acquired cause of renal failure, black race, duration of dialysis, and hemodialysis as a mode of renal replacement therapy ***(Mitsnefes and Stablein, 2005).***

The best method and timing of blood pressure (BP) measurement in end-stage renal disease are subject to controversy. This issue is especially relevant in hemodialysis patients, where unique causes of inaccuracy may exist. The lack of standardization of BP measurement in the dialysis unit may lead to misdiagnosis, so close attention must be paid to technical methods to obtain BP **(*Sankaranarayanan et al, 2004).***

A further, additional problem in the evaluation of BP measurements is that uremic patients can lose the usual diurnal variation in blood pressure, possibly leading to nocturnal hypertension ***(Santos and Peixoto, 2005).***Thus, even patients supposed to be well controlled with daytime BP measurements may be at risk for hypertension-induced cardiovascular morbidity ***(Liu et al, 2003).***

A strong link between blood pressure variations and interdialytic body weight gain, show the important participation of volume state in modulating blood pressure in dialysis patients ***(Kooman et al, 2004).***

Interdialytic BP monitoring with an ambulatory BP monitor is the most reproducible method and is thought to best represent BP in dialysis patients. Alternative forms of BP measurement, such as home BP, 20-minute post dialysis BP, and short (3-hour to 4-hour) ambulatory blood pressure monitoring (ABPM), could prove useful when feasible or available. However, continuous monitoring is warranted in patients suspected of poor control, such as those with large interdialytic weight gain, the results being reasonably reproducible. If available, ambulatory BP is a useful tool to evaluate the quality of BP control in the interdialytic period **(*Sankaranarayanan et al, 2004).***

Aim of the work

To evaluate ambulatory blood pressure monitoring among pediatric patients on regular hemodialysis.

Chapter (1)

Chronic Kidney Disease

Chronic kidney disease is a worldwide public health problem ***(United States Renal Data System, 2000).*** CKD is a serious health problem, often associated with other common chronic diseases such as diabetes, hypertension, and cardiovascular disease (CVD) ***(Go et al, 2004).***

Prior to 2002, the term chronic renal insufficiency was used to characterize patients who had progressive decline in renal function, defined as a glomerular filtration rate (GFR) of less than 75 mL/min per 1.73 m2 body surface area. Chronic kidney disease (CKD) is the new term defined by the National Kidney Foundation Kidney Disease and Outcome Quality Initiative (KDOQI) Group ***(Whyte and Richard, 2008).***

CKD amplifies risk for multiple conditions: cardiac morbidity and mortality risk is elevated 10 times that of population mean risk ***(Gansevoort et al, 2013)*** length of hospital stay and adverse reactions to drugs are also increased ***(Canadian Institute for Health Information, 2014).*** People with CKD also have higher risk of acute kidney injury (AKI) ***(Levin et al,2008)*** AKI in those with existing CKD is associated with high morbidity and mortality ***(KDIGO Clinical Practice Guideline for Acute Kidney Injury,2014a).***

The major outcomes of chronic kidney disease, regardless of cause, include progression to renal failure: