An-Najah National University

Faculty of Graduate Studies

SECONDARY HYPERPARATHYROIDISM AMONG END STAGE RENAL DISEASE PATIENTS IN WEST BANK

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Dedication

To the first teacher of humanity, the Prophet Mohammad, peace is upon him, and to all who have followed his path.

To my father, may God have mercy on him and make him among the people of Paradise.

to my great mother, God prolong her life and protect her.

To my partner in life my wife, and my kids (Abdalhai, Fayez, and Elen).

With whom I huddled around a winter fire, and during the long nights in sweet and bitter times, to my lifetime mates, and my siblings. May Allah protect them from all evil.

I also dedicate this work to the souls of martyrs of Palestine and prisoners of freedom in Israeli jails.

Osaid marie. 2023

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Declaration

I, the undersigned, declare that I submitted the thesis entitled:

SECONDARY HYPERPARATHYROIDISM AMONG END STAGE RENAL DISEASE PATIENTS IN WEST BANK

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

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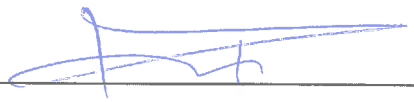
Signature: 

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List of Contents

List of Tables

List of Figures

List of Appendices

SECONDARY HYPERPARATHYROIDISM AMONG END STAGE RENAL DISEASE PATIENTS IN WEST BANK

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Abstract

Background: SECOUNDARY HYPERPARATHYROIDISIM (SPHT) is one of the serious complications in renal failure patients, it occurs when there is imbalance in calcium and phosphorous homeostasis. It's a very important issue because it may lead to many complications such as cardiovascular disease soft tissue and vascular calcification.

Aim: This study aims to determine the prevalence of secondary hyperparathyroidism among end stage renal disease patients in the Palestinian West Bank dialysis centers,and to find if there is a factor that affects PTH levels, furthermore, to highlight hyperparathyroidism widespread for nephrologists to minimize complications that may happen due to hyperparathyroidism.

Methodolgy: This descriptive study was conducted and a cross-sectional design retrospective was used by reviewing patients' medical records for Patients who are receiving dialysis (peritoneal & hemodialysis) in 10- kidney units distributed in different areas in the West Bank of Palestine. Independent T- test used to compare mean and Pearson test were used in the analysis by SPSS to find the correlation.

Results: The study results revealed that 65.1% of the patients have PTH level more than 300 pg/ml, with mean of 602.8 pg/ml ± 551. It also found the mean of calcium was 8.8 mg/dl±1and the mean of phosphorous was 6.5 mg/dl. Regarding the patients with diabetic the results found that 29.7% of them their PTH test was higher than 300 pg/ml level and non diabetic 35.4% and found that non diabetic patients have PTH level more than diabetic according to independent T- test. 39.9 % of males have a PTH level of more than 300 pg/ml meanwhile 25.2 % of females have the same level.20.3% of participants have serum calcium less than 8 mg/dl, and 19.9 % have a serum calcium

level of more than 9.5 mg/d, 39.6 % of participants hyperphosphatemia, independent T - test indicated that there was no difference between gender in PTH level. Patients on dialysis for more than 5 years have a PTH level more than patients with less than 5 years of adherence to dialysis also by using independent T –test also, age didn't have any influence on PTH level. found a negative relationship with a significant difference between PTH level and weight. There is a negative relationship between ferritin and PTH levels with no significant difference for the sample and a significant difference for the patient who has a PTH level of more than 600 pg/ml. Finally, the negative relationship between HGB and PTH levels showed with a significant difference.

Conclusion: SHPT is a very serious problem in ESRD patients which might lead to many complication as of life-threatening complications. Among the hemodialysis population, SHPT is common, which may increase the impact on the patients, patient's relatives, and healthcare professionals. All measures must be taken such as early detection measures to reduce this complication, dialysis adherence and consultation to nephrology care guidelines, inspire patients to follow them often and adhere to their prescribed medications routine laboratory testing, as well as early controlling of anticipated complications.

Keywords: Chronic Kidney Disease; End- Stage Renal Disease; Parathyroid Hormone; Secondary Hyperparathyroidism.

Chapter One
Introduction and Theoretical Background

1.1 Background

Chronic kidney disease (CKD) is a worldwide public health issue, which leads to many complications. These complications lead to the incidence of co-morbidities and mortality According to the national kidney foundation, CKD affects more than 10% of people worldwide, and millions of people lose their life's each year as a result of not being able to afford treatment. For the purpose of staying alive, more than 2 million people around the world today undergo renal replacement therapy (dialysis or a kidney transplant); at present, this statistic may only represent 10% of those who require medical care. Due to the availability of kidney replacement treatments intended for life-saving, but more expensive therapy for patients who are in stage 5 of CKD - end-stage renal disease - (ESRD), the cost of treating CKD increased after the 1960[1],[2]. More than 80% of renal failure patients live in high-income countries with easy access to medical care and a large elderly population. More than 2.5 million patients are undergoing renal replacement therapy, and by 2030, that figure is expected to double to 5.4 million. However, a lack of renal replacement services, the use of bad quality machine, or outdated techniques are common in many countries, particularly developing countries. It is estimated that between 2.3 and 7.1 million adults have prematurely passed away due to this lack of access [3].

According to the renal Disease Outcome Quality Initiative (KDOQI), which defines and categorizes renal diseases, CKD is a disease marked by a progressive decline in kidney function over time, kidney damage, or glomerular filtration rate (GFR) of 60 ML/min/1.73 m2 or less for three months or longer. The kidneys regulate a number of physiological processes, including the manufacturing of the hormone erythropoietin, the intra and extracellular volume status, the acid-base status, the calcium and phosphate metabolism, and the urine excretion of uremic toxins [4]. Albuminuria is a sign of kidney impairment in many kidney disorders, and CKD itself is a risk factor for mortality. Cardiovascular disease and many complications risk raised for all subgroups defined by age, sex, ethnicity, and diabetes and hypertension status there is no subgroup

excluded from the risk for CKD[5]..According to the ministry of health in Palestine 9th cause of death among Palestinians in 2018 [6].

1.1.1 Prevalence of CKD globally

The world at large has identified CKD as a major public health issue. the expected prevalence of CKD is 13.4% (11.7-15.1%) while there are between 4.902 and 7.083 million patients worldwide with end-stage renal disease (ESRD) who require renal replacement therapy (dialysis and kidney transplantation) [8].

Globally, 1.19 million people died from CKD in 2016, a 28.8% rised from 2006. CKD rose from 13th in 2013 to 11th in 2016 as the most common cause of death globally, compared with 27th in 1990. the global prevalence of CKD is suspected to be 11–13%, this number will rise as a result of the aging population and the increasing prevalence of diabetes d and other diseases [9]. The causes of CKD differ among countries, ethnic categories, and age categories. Diabetic induced nephropathy is the most common kidney disease which lead to renal replacement therapy in the America (44%), and the United Kingdom (27.5%). In contrast, glomerulonephritis is the major cause of the end-stage renal disease (ESRD) in China. However, around 10 to 15% of patients become ESRD didn't have a specific renal diagnosis. It is crucial to remember that the range of glomerular disorders altered dramatically over time. This is true of glomerulonephritis all over the world (including Italy, Spain, Denmark, and Japan). Over the past three decades, the prevalence of diabetic glomerulosclerosis has significantly increased in the southeastern United States, going from 5.5% to 19.1% [10].

1.1.2 Prevalence of CKD in the USA.

Data for all stages of CKD have increased steadily in 2019, according to the U.S. Renal Data Annual Data Report. Patients with CKD increased from 13.8% to 14.5% between 2016 and 2017. A third of ESRD patients who developed incidentally in 2017 had received little to no pre-ESRD nephrology medical care. 124,500 new cases of ESRD were documented in 2017, instead of 125,408 the year previously. This reflects developments in renal failure prevention in the United States as a result of measures including better blood pressure management and early recognition of CKD in diabetics patients [11].

- CKD is more prevalent in those over the age of 65 (38%) compared to those between the ages of 45 and 64 (12%) and 18 to 44 (6%).
- Women (14%) have CKD at a little higher rate than males (12%).
- Compared to non-Hispanic White people (13%) and non-Hispanic Asian adults (13%), non-Hispanic Black adults (16%) had a higher prevalence of CKD.
- Approximately 14% of adult Hispanics have CKD [12].

1.1.3 Prevalence of CKD IN EUROPE

An impaired kidney function is characterized by CKD, which affects more than 10% of the population. A study examined CKD prevalence in the European adult population and investigated international variation in CKD prevalence by age, sex, and the presence of diabetes, hypertension, and obesity, 13 European nations contributed the data that was obtained. Among studied populations in Europe, there were substantial variations in the prevalence of both CKD stages 1–5 and stages 3-5 [13].

The adjusted prevalence of CKD stages 1–5 ranged from 3.31–3.33% in Norway to 17.3–18.1% in northeast Germany. Between 1.0% (, 0.7% to 1.3%) in central Italy and 5.9% (5.2% to 6.6%) in northeast Germany, the adjusted CKD stages 3-5 prevalence ranged. Similar to the overall prevalence, there was a variation in CKD prevalence stratified by diabetes, hypertension, and obese status [13].

A considerable variation in CKD prevalence was found throughout Europe, and it seems to be caused by factors other than the incidence of diabetes, hypertension, and obesity [13].

1.1.4 Prevalence of CKD IN AFRICA

A meta-analysis study conducted in 2018 on 98,432 individuals discovered that 4.6% (3.3-6.1) of patients with CKD stages 3-5 and 15.8% (12.1-19.9) for those with stages 1–5 had the disease.

Equivalent percentages were higher in high-risk populations (those with diabetes, hypertension, and HIV), at 32.3% (23.4-41.8), and 13.3% (10.7-16.0) [14].

1.1.5 Prevalence of CKD in Asia

Around 10% the incidence of CKD worldwide, whereas more than 14% of people in Asia are diagnosed. In terms of years of life lost globally, CKDnow ranks 19th, compared with 36th in 1990, according to estimates from the Global Burden of Disease (GBD). The illness is ranked 14th in Asia, significantly higher than the other parts of the world. 119.5 million people in China only suffer from chronic renal disease [15]. The rising rates of diabetes and hypertension are the key factors contributing to the rising incidence of renal disease in Asia. As an example, the demand for dialysis is increasing by around 30% annually in India. The number of people on the continent who require renal replacement treatment due to end-stage renal disease is increasing by more than 12%. In China and Japan, the rising rates of obesity and diabetes as well as population aging have been identified as contributing factors to the increased prevalence of renal disease. High rates of tuberculosis, diarrheal illnesses, and vector-borne infections cause kidney function loss in less developed South Asian nations. These countries have restricted access to nephrologists, a shortage of nephrologists, and frequent medicine shortages. Kidney disorders in Asia are expensive and experiencing rapid expansion because CKD is frequently left untreated in its early stages and is expensive to manage as it develops to end stage renal failure [16].

1.1.6 Prevalence of CKD in the Arab world

There is a shortage of studies on the prevalence of CKD in Arab nations. Most of the information included in current literature reviews comes from small studies conducted in these nations, some of which may only have 100 patients or less. So, the generalizability of these data is limited.

The World Health Organization (WHO) estimates "very high prevalence of diabetes and hypertension and obesity in Arab nations like the UAE, Saudi Arabia, Bahrain, and Kuwait. these factors consider the main cause of CKD, so CKD will be raised due to high percentage of diabetes, hypertension and obesity. The WHO reported that high-income Arab nations represented four of the top five countries with diabetes. regions of focus for diabetes include the UAE (19.5%), Saudi Arabia (16.7%), Bahrain (15.2%), and Kuwait (14.4%) [17] [18] [19].

Middle-aged (45–64 years) and elderly (>65 years) individuals with diabetes are more prevalent in low- and middle-income nations. According to data that is currently available, the prevalence of diabetes has risen from about 3% before 1980 to a current prevalence of (5-16%) in Jordan, Libya, Morocco, and Oman. Diabetes was listed as the primary cause of ESRF in Jordan (29.2%). Diabetes caused 30 %of people with diabetes to develop end stage renal failure in the UAE, so diabetic kidney disease is probably a considerable, almost underreported burden in the Arab world [17].

The prevalence of hypertension is one factor that contributes to CKD. Additionally, 28% of the causes of ESRF in Egypt are due to hypertension. In two separate investigations conducted in Saudi Arabia, the first one discovered a 15.2% prevalence of hypertension while the second, conducted in 2007, discovered a 26.1% prevalence of hypertension. In the Arab world, obesity affects 16–50% of people with diabetes, 20–38% of people with hyperlipidemia, and 24–46% of those with Furthermore, in a review of the prevalence of obesity in the Arab world [17].

1.2 Stages of kidney disease

Kidney disease divided to five stages. The patient's glomerular filtration rate (GFR) calculation stage must be determined by using a laboratory test [20].

The GFR calculates how much blood the kidneys filter each minute (mL/min). Kidney failure occurs when the kidneys are unable to function at the level required for daily life [21]. When kidney function is less than 10% of normal, kidney disease has reached its final stage, known as end-stage renal disease. It is possible to test for protein in the urine as part of the staging of renal disease [22].

The preferred method is to measure the albumin-to-creatinine ratio (ACR) in an untimed samples. It is preferable to measure albumin rather than total protein while total urine protein cannot be quantified in a consistent manner due to its varied composition. [23] Urine albumin testing has recently become standardized because of the adoption of the worldwide standard reference material for measuring serum albumin as the standard reference material [24].

The next table and figure show how can categorize CKD according to albumin to creatinine ratio.

Table 1

Stages of CKD according to GFR and CKD categories according to ACR

Stage	GFR ml/min/1.73 m2	Defined
G1	≥90	Normal or high
G2	60-89	Mildly decreased*
G3a	45-59	Mildly to moderately decreased
G3b	30-44	Moderately to severely decreased
G4	15-29	Severely decreased
G5	<15	Kidney failure
stage	ACR (mg/g)	Defined
A1	<30	Normal to mildly increased
A2	30-300	Moderately increased*
A3	>300	Severely increased**

Abbreviations: CKD, chronic kidney disease; GFR, glomerular filtration rate.
*Relative to young adult level.
In the absence of evidence of kidney damage, neither GFR category G1 nor G2 fulfill the criteria for CKD [22] [23].
Abbreviations: ACR, albumin-to-creatinine ratio; CKD, chronic kidney disease.
*Relative to young adult level.
**Including nephrotic syndrome (albumin excretion ACR >2220 mg/g) [22] [23].

Figure 1

Calcification of patients based on GFR and albuminuria

Guide to frequency of monitoring (number of times per year) by GFR and albuminuria category				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30–300 mg/g 3–30 mg/mmol	>300 mg/g >30 mg/mmol
GFR categories (ml/min per 1.73 m²) Description and range	G1	Normal or high	⩾90	1 if CKD	1	2
	G2	Mildly decreased	60–89	1 if CKD	1	2
	G3a	Mildly to moderately decreased	45–59	1	2	3
	G3b	Moderately to severely decreased	30–44	2	3	3
	G4	Severely decreased	15–29	3	3	4+
	G5	Kidney failure	<15	4+	4+	4+

GFR and albuminuria grid to reflect the risk of progression by intensity of coloring (green, yellow, orange, red, deep red). The numbers in the boxes are a guide to the frequency of monitoring (number of times per year).

Note: Calcification of patients based on GFR and albuminuria [25]

Due to the significance of albuminuria in determining risk and individualized treatment, it was included in all GFR categories. The three categories, are represented by the albumin-to-creatinine ratios (ACR) of 30, 30-300, and >300 mg/g. which have previously been referred to as normal albuminuria, Patients with ACR >30 mg/g are more likely to experience all of the abovementioned consequences. [25]

1.3 Risk factors of CKD

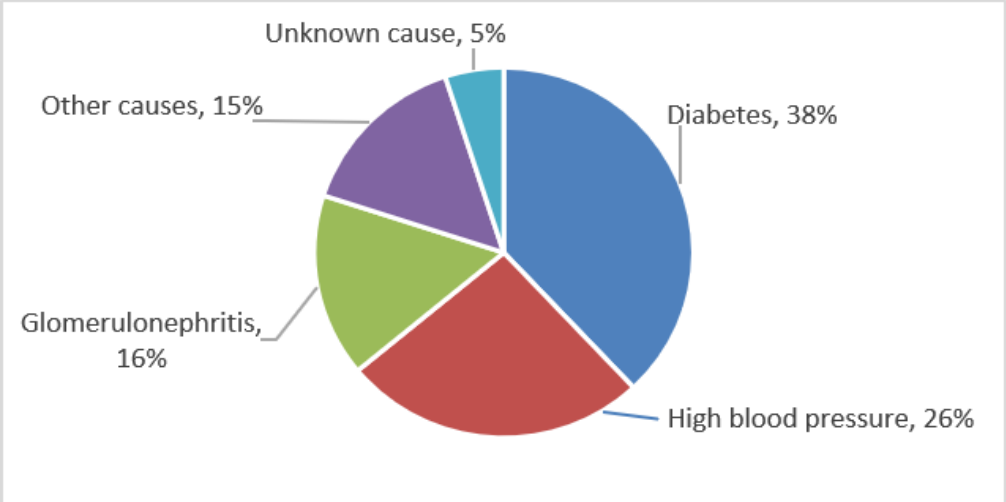
The Cause of CKD is classified based on the presence or absence of systemic disease and the location within the kidney of observed or presumed pathologic-anatomic findings on kidney biopsy or imaging. Determine the origin of CKD to determine whether the patient has a localized kidney problem like glomerular disease or a systemic condition that influences management and treatment. [22][23]. The table in the appendices A shows the classification of CKD based on the presence or absence of systemic disease and the location of the pathologic-anatomic finding:

More than one in seven Americans, or over 37 million people, may have CKD(CKD) in 2019, according to the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Diabetes is the main risk factor in CKD. After diabetes, high blood pressure is the second most common cause of kidney failure in the USA.

The next figure shows the percentage of the causes of CKD in the USA in 2019 [26].

Figure 2

percentage of the causes of CKD in the USA in 2019



1.4 End-stage renal disease

End-stage kidney disease (ESRD) is the final stage (stage 5) of CKD, which means kidneys are only performing at 10 to 15 percent of their normal performance. when kidney function become low it can't filtrate blood from waste and remove extra fluid. Kidneys are also responsible for other body functions, such as regulating electrolytes and producing specific hormones. When CKD progresses to ESRD, dialysis is used to treat the condition OR kidney transplant. Anemia, bone and mineral metabolism abnormalities, dyslipidemia, fluid retention (extracellular volume overload), and protein-energy deficiency are only a few of the adverse alterations that result from reduced or absent renal function [27].

The onset of CKD and the development of this terminal illness as a result of CKD continue to be important causes of reduced life expectancy and significant early mortality. End-stage renal disease (ESRD) affects more than 500,000 persons in the USA [22].

1.4.1 Etiology of end stage renal disease

As previously mentioned, a variety of chronic illnesses can lead to end-stage renal failure. The main cause is diabetes mellitus. The urinary tract obstruction for an extended period of time, vesicoureteral reflux, recurrent pyelonephritis, hypertension, glomerulonephritis, polycystic kidney disease. some medications, such as non-steroidal anti-inflammatory drugs (NSAIDs), calcineurin inhibitors, and antiretrovirals are additional causes [28].

1.4.2 Epidemiology end stage renal disease

The United States Renal Data System reports that 124,411 new cases of ESRD were diagnosed in 2015, indicating an increase in the burden of kidney failure. [29].

1.4.2.1 International occurrence

Japan has been found to have the greatest prevalence rate for ESRD on treatment, followed by Taiwan and finally the United States. 58% of people with ESRD worldwide reside in just 5 nations: the United States, Japan, Germany, Brazil, and Italy [30].

1.4.2.2 In the united state of America

The incidence rate for end-stage renal disease (ESRD) remained largely steady in 2007 at 354 cases per million, with a total population requiring dialysis of more than 368,000 (more than 90% on hemodialysis). While prevalence rates keep rising as ESRD patients live longer due to advancements among hemodialysis and equipment technology. According to estimates, more than 750,000 Americans will have ESRD by 2020 [31].

1.4.2.3 Sex-related demographics

Men are slightly more likely than women to have ESRD (male to female ratio, 1.2:1). Due to lower muscle mass and baseline blood creatinine levels, as well as being more likely to develop uremic symptoms at lower creatinine levels related to the causes mentioned above [32].

1.4.2.4 In Palestine

1.4.2.5 Age-related demographics

ESRD is more exist in older adults, Individuals aged 65 years and more have experienced the greatest increase in incidence (98% over the last decade), because improved survival of people with diseases such as (cardiovascular disease and diabetes mellitus), and expanded access to renal replacement therapy for older patients and high-quality machines used in the treatment [33],[34].

1.4.3 Treatment of end-stage renal disease

When the Patient become end-stage renal disease or stage 5 of CKD there are two methods only for treatment:

1- dialysis: dialysis is a medical procedure that attempts to take the role of several important kidney processes by filtering waste and excess water from the blood using a machine. Hemodialysis and peritoneal dialysis are two different types of dialysis.

2- Kidney transplant: A surgical operation is used to replace a failed kidney when the transplant recipient has developed a healthy kidney and can resume his normal activities [35].

1.5 Hyperparathyroidism

Hyperparathyroidism is a serious disease of parathyroid glands. The increased Parathyroid gland's hormone level without any cause is called primary hyperparathyroidism, and secondary hyperparathyroidism (SHPT) is characterized by high parathyroid hormone levels and low blood calcium. when some other disease affects the parathyroid gland and increase stimulation of gland to increase secretion of hormones called secondary hyperparathyroidism.

Secondary hyperparathyroidism defined is as a disease of the parathyroid glands caused by some other disease.

Secondary hyperparathyroidism related to renal disease A condition characterized by improper parathyroid hormone (PTH) release as a result of impaired kidney function. In this syndrome, a disease that originates outside of the parathyroid glands alters, enlarges, and hyper activates all of the parathyroid glands.

The parathyroid glands secrete parathyroid hormone (PTH), which affects how calcium and skeletal metabolism.[36].

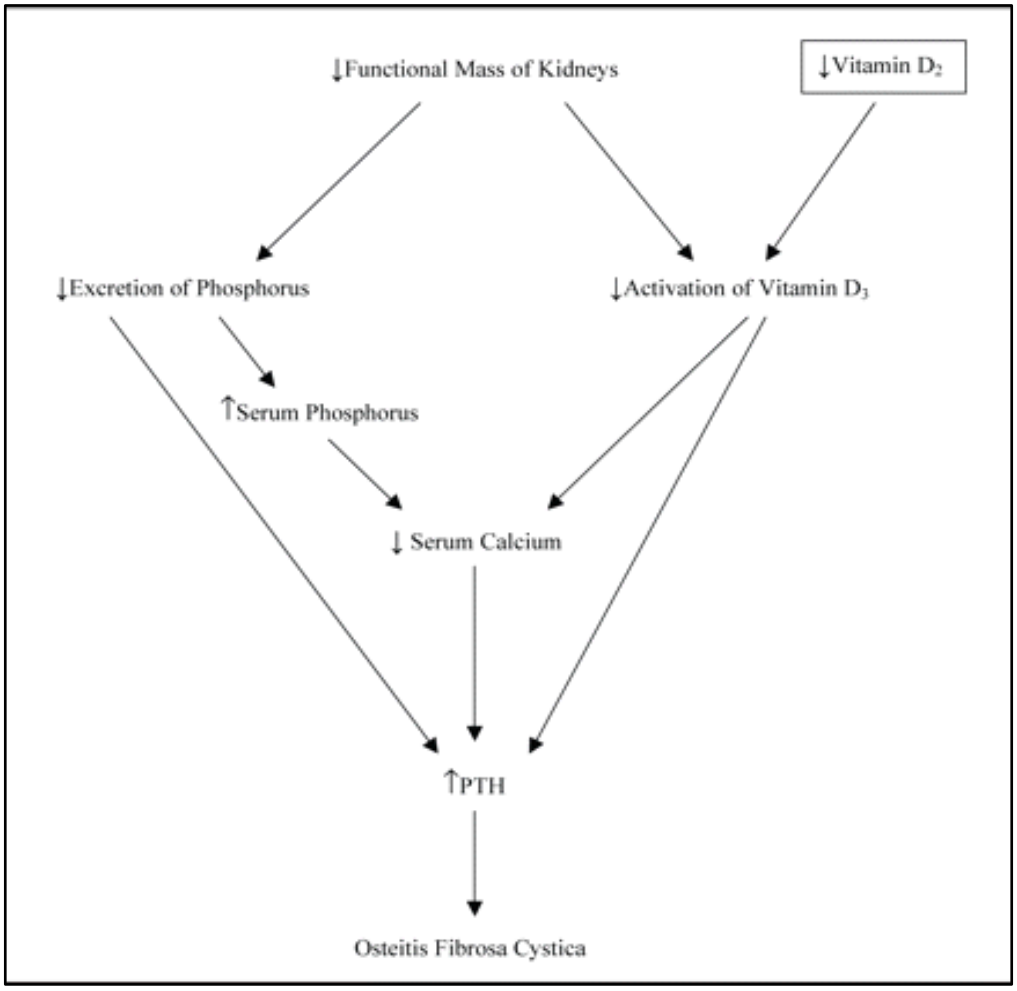
1.5.1 Pathophysiology Hyperparathyroidism

Among secondary hyperparathyroidism caused by kidney failure, Due to the kidney's inability to create enough vitamin D or remove the phosphorus the body produces, results in decreasing calcium levels in the blood. When calcium levels fall, the parathyroid glands are stimulated to make more PTH [37]. The parathyroid glands enlarge and become overactive over time as a result of persistent stimulation, and patients eventually develop secondary hyperparathyroidism. PTH levels among patients with secondary hyperparathyroidism and renal failure are high (in the hundreds to thousands) [36] [38].

Decreased Glomerular Filtration Rate (GFR) also causes increased PTH release among patients with chronic renal disease. However, a decline in GFR results in a reduction in phosphate clearance and hyperphosphatemia, which in turn produces hypocalcemia (phosphorus forms complexes with calcium) PTH secretion is triggered by hypocalcemia. [36] [38][39][40].

Figure 3

Pathophysiology of secondary hyperparathyroidism



Note: Pathophysiology of SHPT [38]

1.5.2 Treatment / Management

1.5.2.1 Medical Treatment

The reason why management maintaining normal vitamin D levels combined with keeping PTH under control and serum calcium and phosphorus levels within the usual range. therapy consists of:

1- Phosphate binders (lanthanum carbonate, sevelamer carbonate, sevelamer hydrochloride, and aluminum hydroxide).

2- The replacement of vitamin D with ergocalciferol, or vitamin D20, and cholecalciferol, or 1,25-dihydroxyvitamin D3.

3- Calcimimetics for calcium and phosphate level control. Calcimimetics, such as Cinacalcet and Etelcalcitide, are substances that make calcium-sensing receptors more sensitive.

4- Limit the amount of phosphate-rich foods that consume, such as meat, cheese, nutritional supplements, coke cola, chocolate, and nuts. [31] [42] [43] [44].

1.5.2.2 Surgical Treatment

If medicinal therapy is unsuccessful or refractory, a surgical operation known as a parathyroidectomy may be performed to partially or completely remove the parathyroid gland. Anemia caused by hyporesponsiveness to erythropoietin replacement therapy, calcification in blood vessels, severe itching, severe hypocalcemia or hyperphosphatemia, PTH levels greater than 800 pg/mL (for more than 6 months despite medical therapy), and extraskeletal calcification are all indications for parathyroidectomy [42][43] [44] [45].

Hypocalcemia is delivered on by a postoperative condition called "hungry bone syndrome" due to reduced PTH. thereby, after a parathyroidectomy, the patient must consume large amounts of calcium and use post-surgery dialysis with a high calcium concentration. [43] [44] [45].

According to research, people with CKD who are stage 3, stage 4, or stage 5 are at risk for SHPT. To avoid or manage issues that will result from SHPT, early detection, diagnosis, and treatment of SHPT are essential. The most challenging aspect of SHPT treatment is patient adherence and acceptance [3] [23].

Complicated medication regimens that require multiple daily doses, expensive medication, co-morbid conditions, financial limitations, psycho-social issues, and dietary restrictions are all factors that contribute to lower treatment success rates and higher non-adherence rates. The main issue for all healthcare professionals is to keep bone and mineral metabolism in SHPT patients within normal limits. This needs a multidisciplinary team approach that includes physicians, nurses, psycho-social workers, and pharmacists [42]. Dietitians may work closely with patients to create dietary programs that limit phosphorus intake while ensuring adequate protein intake in the management of SHPT. [38] [44].

Positive reinforcement and encouraging adherence to diet, exercise, and medications are essential for the effective management of SHPT [38] [43].

1.6 Significance of study

In the last few years there is development in manufacturing medication for hyperparathyroidism, and critical care for kidney failure there is a significant increase in hyperparathyroidism among dialysis patients in the world, but we currently lack our country (Palestine) reliable data on the prevalence of hyperparathyroidism among dialysis patients, this study will determine the prevalence of hyperparathyroidism among end-stage renal disease on hemodialysis and peritoneal dialysis therapy in the West Bank in Palestine.

This study highlighted the seriousness of the problem and to draw attention of physicians to this problem to reduce co-morbidities and complications of hyperparathyroidism,to enhance the quality of care provided to these patients and ultimately improve their overall health outcomes.

1.7 Problem statement

There are many complications ofsecondary hyperparathyroidism are mainly related to the long-term effect of too little calcium in the bones and too much calcium in bloodstream. Common complications include: Osteoporosis. The loss of calcium from bones often results in weak, brittle bones that break easily and extra calcium in blood stream lead to vascular and cardiac calcification. These complication to co-morbidities and early dyeing.

1.8 Aim of study

This study aims to determine the prevalence of secondary hyperparathyroidism among end-stage renal disease patients in West Bank dialysis centers, determine the factor affect increasing PTH levels.

1.9 Research Objectives

1- Determine the prevalence of secondary hyperparathyroidism among end-stage renal disease.
2- Highlight and draw attention to the percentage of patients who suffer from secondary hyperparathyroidism.
3- To identify the factors that contribute to or increase susceptibility to secondary hyperparathyroidism.

4- To evaluate the need for routine examination and modify treatment to reduce complications.

1.10 Research questions

RQ 1: What is the prevalence of secondary hyperparathyroidism among end-stage renal disease patients who are on dialysis?

RQ 2: are non- diabetic patients have hyperparathyroidism more than diabetic among end-stage renal disease?

RQ 3: Is there a difference in PTH level between gender among end-stage renal disease?

RQ 4: Is the prevalence of secondary hyperparathyroidism among patients on dialysis for more than 5 years a high percentage than among patients on dialysis for less than 5 years?

RQ 5: Is there difference in PTH level in patients who are committed to medication and patients not committed?

RQ 6: is the PTH level in a patient less than 40 years old higher than in a patient more than 40 years old?

RQ7: is there a relationship between weight and PTH level?

RQ 8: is There correlation between PTH and ferritin?

RQ 9: is There correlation between PTH and hemoglobin (HGB)?

1.11 Hypothesis

- more than 50% of participants have PTH levels of more than 300 pg /ml.
- Diabetics patients have a low level of PTH than non-diabetics patients.
- There is deference's between gender in relation PTH level.
- patients on dialysis for more than 5 years have a PTH level more than patients less than 5 years on dialysis.
- patients not committed to medication have PTH levels more than committed patients.
- patients less than 40 years old have a PTH level more than patients older than 40 years.
- there is a positive relationship between PTH level and weight.
- There is negative correlation between PTH and ferritin.
- There is negative correlation between PTH and hemoglobin (HGB).

1.12 Literature Review

In this chapter will present a summary of available research on secondary hyperparathyroidism WITH CKD and ESRD patients.

- Ali Owda found in his study done in Michigan state in the USA,78% percent of the patients had PTH more than 200 pg/mL, 19% had PTH within the accepted normal range, and 3% had levels under 100 pg/mL. Also found Phosphate, calcium, calcium phosphate product, age, and time on dialysis are the important factors correlating with elevated PTH. Also, Ali found no relationship between diabetic and non-diabetic patients in increasing PTH level [46].

- The burden of secondary hyperparathyroidism and chronic renal disease worldwide was examined in a 2015 study by Elizabeth Hedgeman, who showed that the prevalence of SHPT among stage 5 populations varied greatly. Nearly 30–50% of stage 5 CKD patients had blood parathyroid hormone levels greater than 300 pg/mL in the few reporting nations. They discovered that estimates of incidence and prevalence within each country varied, indicating the influence of factors such as population demographics, risk factors, etiologies, and access to therapy at all stages of CKD [47].

- A 2013 study on 1210 patients was conducted in 25 hemodialysis facilities in Argentina by (Walter G. Doouthat, et al). The average patient age was 55.3 17.6 years, and 29.1% of patients had diabetes. Additionally, 60.8% of patients were male and 3.3% underwent peritoneal dialysis. According to the study, secondary hyperparathyroidism is highly prevalent and a large percentage of patients have BMM indicators that are outside of the recommended ranges by K/DOQI. The study also discovered that 24.4% of patients had PTH levels below 150 pg/ml and 21.1% had appropriate PTH levels (150-300 pg/ml), with 51.6% of patients having enough calcium levels (8.4-9.5 mg/dl) and 51.6% having adequate phosphorus levels (3.5-5.5 mg/dl). And 54.5% had levels more than 300 pg/ml. 28.3% of people had PTH levels above 600 pg/ml, while 13.3% had levels above 1000 pg/ml. In order to sum up, the patient takes phosphate-binding medications based on calcium and calcitriol [48].

- In a 2017 study by Seyed M. M. Movahed on 45 HD patients in Iran, 19 women (42.2%) with a mean age of 6014.3 years were included. According to the study,

patients with ESRD frequently have PTH abnormalities and impairments of mineral metabolism. According to (K/DOQI) standards for mineral metabolism, was discovered that 28.9% of patients had serum calcium levels below 8.4 mg/dL whereas 28.9% of our patients had serum calcium levels within the normal range (8.4 to 9.5 mg/dL). While 31.1% of HD patients had serum phosphorus levels above 5.5 mg/dL, about 60% of our patients accepted the normal range of serum phosphorus (3.5 to 5.5 mg/dL). also observed In the acceptable range for PTH levels in HD patients, 16 patients (35.55%) had levels between 150 and 300 ng/mL. PTH values in 17 patients (37.78%) were above the recommended range [49].

- Jose Carlos Arevalo-Lorido conducted a study in Spain in 2016 to determine if there is a difference in the prevalence of SHPT between diabetic and non-diabetic CKD. A total of 409 individuals (214 diabetics) were included in the study. Compared to non-diabetics, 60.4% of diabetics had HPTH, but they were younger (79.5 vs. 82.3 years old) and had more co-morbid conditions, such as hypertension and dyslipidemia [50].

- About 72% of participants in a 2019 study conducted in India by Chiranjee Lal Dayma had secondary hyperparathyroidism. The patient's serum calcium level was low when they had hyperparathyroidism. The levels of serum phosphorous and serum PTH were positively correlated. I discovered Compared to individuals with hypertension, CRF patients with normal blood pressure had a higher prevalence of hyperparathyroidism [51].

- Fatemeh Hayati in 2016 was found in her study done in Iran on 112 hemodialysis (HD).78 patients had intact PTH more than 300ρg/mL, 22 patients had intact PTH between 150- 300 ρg/mL, and 12 patients had intact PTH under 50 ρg/mL according to results prevalence of hyperparathyroidism high [52].

- FinallyAyham Haddad (2015) conducted the study in Jordan on the 276 patients that were involved in it. He discovered secondary hyperparathyroidism in 57.5% of men and 43.5% of women, with an average parathyroid hormone level of 887.1 pg/ml. Another patient had a low average parathyroid level of 32.9pg/ml and an adequate average parathyroid hormone level for hemodialysis patients of 127.7pg/ml (13.4%). According to this finding, ESRD patients have a significant prevalence of hyperparathyroidism [53].

Sikole discovered in 2000 that excessive quantities of parathyroid hormone (PTH) suppress the erythropoietin receptors on erythroid progenitor cells in the bone marrow, which interferes with normal erythropoiesis. As a result, normocytic and normochromic anemia results when physiologic quantities of EPO are no longer sufficient to maintain normal red blood cell counts. This effect is seen in primary hyperparathyroidism (HPT) with extremely high PTH concentrations. This effect is especially pronounced in secondary HPT in chronic renal failure due to reduced erythropoietin production.[54]

Chapter Two
Research Methodology

2.1 Introduction

In this chapter, I will discuss the type of study, study design, population, setting, sampling, inclusion and exclusion criteria, tools that were used in the study, data collection process, dependent and dependent variable, and ethical considerations.

2.2 Study Design

Quantitative research, descriptive form, cross-sectional design suitable to assess the prevalence of SHPT. Retrospective study by back to medical record or database (as available).

2.3 study Setting

This study was carried out in Palestinian governmental hospitals in the west bank at dialysis centers (except Alia hospital), also there is a private kidney unit included in the study at al-Najah national university hospital (NNUH) in the west bank in Palestine because only this is the private kidney unite in Palestine.

2.4 Population of study

The target population for this study includes all end-stage renal disease (ESRD) patients who come to dialysis centers to do hemodialysis (HD) or peritoneal dialysis (PD), with patients of both genders included in this study, number of samples 988 patients.

2.5 Sampling of the Study

The convenience sample technique was used participant was taken from all dialysis centers, the patient's who's undergoing to do dialysis at the Ministry of Health Governmental Hospitals on the west bank (The Martyar Dr. Khalil Sulaiman governmental hospital [Jenin hospital], The Martyar Dr. Thabet Thabet governmental hospital [Tulkarm hospital], Tubas Turkish governmental hospital, The Martyar Yaser Arafat governmental hospital [Salfit hospital], Jericho governmental hospital, Beit Jala governmental hospital [Alhusain], Abo Alhasan Alqasem governmental hospital [

Yatta]), and the private center in the west bank at An-Najah National University Hospital (NNUH).

2.6 Sample Size Calculation

In 2020 according to the ministry of health in Palestine, the number of patients who received dialysis service in hospitals regularly reached 1573,[33] patients, The study sample was calculated using the following equation:

Sample size (SS) = n= N/1+N (e)^2 [1]

Where: n: sample size, N: number of populations, e at the level of confidence0.95% e = 0.05 [54].

So: 1573/1+1573(0.05)^2

according to the sample size calculation the sample size was 309, but in this study convenient sample for all centers of dialysis so the sample size reached 988 patients.

2.7 Inclusion Criteria

All patients who are doing dialysis and diagnosed with end stage renal disease (ESRD) adults and children.

2.8 Exclusion Criteria

1. dialysis patient diagnosed with acute kidney failure.
2. a patient who removes the parathyroid gland (parathyroidectomy).
3. Centers that the head of the department refuses to include his patient in the study.
4. Patient has diagnosed with hyperparathyroidism before becoming a renal disease patient.
5. Patient who started dialysis less than 6 months.
6. Centers that didn’t do serum PTH regularly.
7. Centers that never do serum PTH.

2.9 Data Collection

2.9.1 Data Collection Process

The researcher met the director and head nurse of dialysis units in governmental hospitals and An-Najah national university hospital (NNUH)to explain the purpose of the study before starting the data collected, all permission was taken before stat data collection. After obtaining permission from the head of the hospital and the head of the department, the data collection has been accomplished by visiting each hospital to look through the patient's files along with Electronic medical records to gather the data. In hospitals that didn't have electronic files data was collected from paper medical files, and data collection took place from July 2021 to October 2021.

2.9.2 Data Collection Tool

The tool used self-building tools, containing demographic data, medical history, lab tests for patients who were done before, and medication for hyperparathyroidism, [for more details see appendix A].

2.10 The variable of Study

2.10.1 Independent Variable

end stage renal disease the independent variable.

2.10.2 Dependent Variable

Patient with Hyperparathyroidism is the dependent variable

2.10.3 CO-Variable of Study

Age, sex, duration of dialysis, years spend on dialysis, diabetes or hypertension, cause of dialysis, weight, serum PTH, serum calcium, serum phosphorus, serum albumin, hemoglobin, blood urea nitrogen, serum creatinine, serum ferritin, medications of the patient for hyperparathyroidism.

2.11 Hematology and biochemistry and serology cut points

1. Hemoglobin: In the past, Medicare recommended a Hgb target level of 10–12 g/dL, while the Kidney Disease Outcome Quality Initiative (KDOQI) guidelines from the National Kidney Foundation (NKF) from 2000 recommended an HGB of 11–12 g/dL.

   The Centers for Medicare and Medicaid Services (CMS) introduced reimbursement standards in April 2006, which signaled an increase in the mean Hgb among dialysis patients and led to a Hgb of 13 g/dL. The cumulative findings of three studies indicate that it is challenging to maintain a Hgb level in the 11–12 g/dL range [55][56].
2. adults and children >15 years with CKD HGB concentration must be > or = 13.0 g/dl (o130 g/l) in males and > or=12.0 g/dl (o120 g/l) in females. In children with CKD if Hgb concentration must be >or =11.0 g/dl (o110 g/l) in children 0.5–5 years, > or =11.5 g/dl (115 g/l) in children 5–12 years, and > or =12.0 g/dl (120 g/l) in children 12–15 year [57].
3. Serum PTH: normal range of PTH 15- 65 pg/ml in patients with CKD G5D (ESRD) KIDGO suggests maintaining PTH levels in the range of approximately 2 to 9 times the upper normal limit for the assay so the range for ESRD from (100– 500 pg/ml) [59].

   In our study, the PTH cut point used 300 pg/ml like in previous studies [48] [49] [52] [60] [61].
4. Serum phosphorous: 3.5 to 5.5 mg/dL (1.13 to 1.78 mmol/L) [59].
5. Serum calcium: 8.4 to 9.5 mg/dL (2.10 to 2.37 mmol/L) [59].
6. Serum albumin: 3.5 to 5.5 g/dL But ESRD should remain more than 4 g/dl [62].
7. Serum ferritin: target value for ESRD 500< or = ng/ml [57].

2.12 Data Analysis

All data collected from 988 participants were entered into the computer. Statistical Packages for Social Science SPSS Program version 20 was used for data analysis.

Independent sample T-test was used for mean comparing used to compare (diabetic and no-diabetic patients, gender, period on dialysis, committed and not committed to medication patients and age) with PTH level, where Pearson correlation test was used to find the correlation relationship between variables (weight , ferritin , hemoglobin).

2.13 Ethical Considerations

- Approval from the institutional review board (IRB). [see appendix b]
- Approval from the ministry of health for permission to apply for this study. [see appendix c]
- Approval from An-Najah national university hospital (NNUH) for permission to apply for studies. [see appendix d]
- The purpose of the study was explained to the head of the dialysis department before starting data collection. [appendix e]

Chapter Three
Results

3.1 Introduction

This chapter presents the results of the data analysis. it includes demographic data and characteristics of sample respondents, answering hypothesis and research questions, also another correlation test between PTH and some of the laboratory tests and factors (hemoglobin, albumin, ferritin and weight).

3.2 Distribution of respondent's percentages according to their demographic data

The beginning of the result for frequencies of the respondent according to demographic data, which shows about 988 of respondents who attended dialysis included in this study from governmental and private hospitals in the west bank. The study enrolled participants from all age groups, with mean 54.4 ±16.107. The results show that 60.2% of respondents are males. The mean of respondents' weight was 75.7 ±16.146, and 37% of participants weight more than 80 kg. (for more details APPENDICES F).

3.3 Distribution of respondent's percentage and mean according to medical overview data

The table 2 in the annex presented a medical overview for respondents such as (medical history, type of dialysis, how much spent on dialysis, and how much they visit nephrologists). It presented that 48.6% of respondents have DM, and 78.6% of them have HTN. When we categorize respondents according to PTH value we note that a high percentage of respondents have DM and HTN in patient PTH more than 300 pg/ ml (in people who has the critical situation of hyperparathyroidism). The table also showed that 91.9% of participants were on hemodialysis and 8.1% of them were on peritoneal dialysis.

The results show that the highest mean of adherence on dialysis was for patients who have a PTH level of more than 600 pg/ml which reached 4.5 ± 3.3. And the mean for all respondents reached 3.8 ± 2.99, where the lowest mean was for the patients who have PTH levels lower than 150 pg /ml which reached a mean of 3± 2.3 years.

it also shows that the mean of respondents who visit the nephrologist reached 0.89 ± 0.307, and when categorizing the sample according to PTH level we note that the lowest mean0.81 ± 0.389 of visits was for people who have PTH of more than 600 pg/ml.

Finally, the table shows the causes of end stage renal disease (cause of renal failure), where the major cause of ESRD was HTN, with a percentage reached 51.9%, the second cause was DM with a percentage of 29.2%, and the last causes grouped in others (medication overuse, polycystic kidney, nephritis, reflux, autoimmune disease) reached only 18.9% for all of them. (for more details see APPENDICES G) .

3.4 Mean of laboratory investigation data for a participant

This result reflects an overview picture of the laboratory investigation for the respondent for the sample and after categories of the sample according to PTH. it showed that (for more details see appendix h).

3.5 frequencies and percent of participants according to laboratory investigation

The result shows 20.3 % of participants have serum calcium of less than 8 mg/dl and 20 % while 59.7 % have a normal range of serum calcium, and 39.6 % of participants have serum phosphorous of more than 5.5 mg /dl. 24.4% of participants have hemoglobin levels less than 9 g/dl. 20.7% of participants have serum ferritin less than 200 ng/ml and 44.9% have serum ferritin of more than 600 ng /ml. finally, 45.5 % of participants have serum albumin of more than 4 g/dl and only 4.5 % have serum albumin of less than 3 g/dl. (for more details see appendix i).

4.6 Distribution of respondents according to medication that control PTH level

In this study, we find the percentage of participants related to taking medications, The result in the table show the type and doses of medication taken by patients,it shows that91.9 % of respondent take alphaD3 in different doses, and 59.4% take calcium supplement in different doses 5.4% on phoslo and 22.3 % on sevelamer in different doses (for more details see appendix j) .

3.7 Distribution of respondent percentage according to the dialysis center

The distribution and percentage of the respondents according to governorate in the west bank, we note that the highest percentage of respondents were from Nablus about 34.1%, then Ramallah and Jenin, with 15.8% and 14.3% respectively, other dialysis centers have only 10% or less of respondents. (for more details see appendix k) **.**

3.8 Prevalence of secondary hyperparathyroidism in end stage renal disease

RQ1: What is the prevalence of secondary hyperparathyroidism in end-stage renal disease patients who are on dialysis?

Hypothesis 1: more than 50% of participants have a PTH level of more than 300 pg /ml.

Table 2

frequencies of respondents according to PTH value, PTH categories, mean, and SD

Intervals of PTH testpg/ml	No.	N%	Mean of PTH	SD
Less than 150	148	15	94.8	38.6
150-300	197	19.9	221.5	44.1
300-600	287	29	441	81.8
More than 600	356	36.1	1155.5	556.9
Total respondent	988	100	602.8	551

Table (2) showed that the total mean for PTH test reached 602.8 pg/ml ± 551. at the level of PTH intervals (4 intervals), it also showed that 36.1% of respondents have high level of PTH value for the interval (more than 600 pg/ml) with mean of 1155.5 pg/ml ± 556.9 for PTH test value, the cut pinot in the study for PTH more than 300 pg /ml , in the study find that 65.1% of respondents have PTH level more than 300 pg/ml.

In the other hand 15% of respondents have hypoparathyroidism with mean reached 94.8 pg/ml ± 38.6 of PTH test value pg/ml, so the preferable value for PTH test is from 150-300 pg/ml, but in our study they reached only 19.9% from all respondents with mean reached 221.5 pg/ml ± 44.1.

the table shows that 65.1% of participant's have PTH level more than 300 pg/ml , this result accept the first hypothesis about more than 50% of participant have PTH level more than 300 pg/ml .

3.9 Independent sample T-test to find that diabetics have low serum PTH than non-diabetic patients among end-stage renal disease.

RQ 2: are non- diabetic patients have hyperparathyroidism more than diabetic among end-stage renal disease?

Hypothesis 2: diabetic patients have low serum PTH vs. non-diabetic patients among end stage renal disease.

Table 3

Independent T-test to find that diabetics have low serum PTH vs. non-diabetic patients among end-stage renal disease

Intervals of PTH testpg/ml	Group statistics					T-test for equality of means	
	Diabetes	N	%	Mean	S. D	t-value	P-value
less than 150	DM	83	8.4	97.87	34.796	1.060	0.291
	Non DM	65	6.6	90.93	42.928		
150 – 300	DM	104	10.5	219.09	41.564	-0.806	0.421
	Non DM	93	9.4	224.20	46.856		
300 – 600	DM	150	15.2	441.81	79.48	0.167	0.868
	Non DM	137	13.8	440.20	86.116		
more than 600	DM	143	14.5	1000.40	456.090	-4.582	0.000
	Non DM	213	21.6	1259.61	609.661		
Total respondent	DM	480	48.6	500.49	430.780	-5.826	0.000
	Non DM	508	51.4	599.54	629.666		

This table shows that 48.6 % and 51.4% of the participants are diabetic and non diabetic respectively, with significant differences between themean of DM and non-DM. At the level of PTH intervals the results cleared that there is no significant difference between PTH and diabetic for first three intervals: (less than 150, 150 – 600

and 300 – 600), where the P-value was higher than confidence value ($\alpha \leq 0.05$) for each. this result accept second hypothesis that diabetic patients have low PTH level.

3.10 independent T-test to find the difference in the occurrence of secondary hyperparathyroidism related to gender among end stage renal disease

RQ3: Is there a difference in PTH level between gender among end-stage renal disease?

Hypothesis 3: There is deference's between gender in relation PTH level.

Table 4

Independent T-test to find the difference in the occurrence of hyperparathyroidism related to gender among end stage renal disease

Intervals of PTH testpg/ml	Group statistics					T-test for equality of means	
	Gender	N	%	Mean	S. D	t-value	P-value
less than 150	M	84	8.5	101.35	36.075	2.359	0.120
	F	54	5.6	86.25	40.371		
150 – 300	M	117	11.9	225.18	43.295	1.416	0.162
	F	88	8.9	216.14	44.988		
300 – 600	M	185	18.7	441.10	79.48	.017	0.986
	F	102	10.5	440.96	86.116		
more than 600	M	209	21.1	1134.64	545.077	-.831	0.406
	F	147	14.8	1185.29	597.160		
Total respondent	M	595	60.2	594.25	527.010	-0.602	0.556
	F	393	39.8	615.83	585.986		

According to the table we note that 60.2% of respondent are males and only 39.8% are females. Independent T- test done to find if their different of occurrence of hyperparathyroidism between male and female , on sample at all found that's no significant different of occurrence of hyperparathyroidism between male and female where p value (0.556) which is higher than significant point 0.05 , and no significant difference for categories (150-300, 300-600,and more than 600 pg/ml) where p value (0.162, 0.986, 0.406) respectively which is more than significant point 0.05 this result reject hypothesis that no relationship between gender and PTH .

3.11 Independent sample T-test for the testing prevalence of secondary hyperparathyroidism in patients on dialysis for more than 5 years high percent than patients on dialysis for less than 5 years

RQ4: Is the prevalence of secondary hyperparathyroidism in patients on dialysis for more than 5 years high percent than in patients on dialysis for less than 5 years?

hypothesis 4: patients on dialysis for more than 5 years have PTH level more than patients less than 5 years on dialysis.

Table 5

Independent sample T-test for the testing difference in PTH level in patients on dialysis for more than 5 years high percent than patients on dialysis for less than 5 years

Intervals of PTH test pg/ml	Group statistics					T-test for equality of means	
	Years on HD	N	%	Mean	S. D	t-value	P-value
less than 150	1 - 4.9	125	12.7	93.79	38.88	0.760	0.449
	More than 5	23	2.3	100.45	37.36		
150 – 300	1 - 4.9	157	15.9	220.96	43.77	0.344	0.731
	More than 5	40	4.0	223.65	45.89		
300 – 600	1 - 4.9	220	22.3	435.25	79.85	2.189	0.029
	More than 5	67	6.8	460.06	85.60		
more than 600	1 - 4.9	223	22.6	1079.64	513.67	3.314	0.001
	More than 5	133	13.5	1282.65	628.10		
Total respondent	1-4.9	725	73.4	528.18	482.541	7.253	0.000
	5+	263	26.6	808.64	665.164		

The test find there is a significant difference between PTH level and period on dialysis the sample at all which (p = 0.000) and this is lower than the confidence value (p =0.05), while the sample was categorized for intervals also there are significant differences for the last intervals of PTH level (300-600 more than 600pg/ml), where the values of (P=0.029 and 0.001) respectively, which are lower than the confidence value ($\alpha \leq 0.05$),meanwhile for intervals of PTH (less than 150, 150 – 300pg/ml), where the values of (P =0.449 and 0.731) for each respectively, which higher than the confidence value ($\alpha \leq 0.05$). this result accept hypothesis that patients on dialysis more than 5 years

have high PTH level more than patients less than 5 years on dialysis. This result indicates that period of dialysis therapy affects positively PTH levels in ESRD patients.

3.12 Independent sample T-test for the testing difference in PTH level in patients on dialysis inpatient not committed in take medication more than in patients committed

RQ5: Is there difference in PTH level in patients who are committed to medication and patients not committed?

Hypothesis 5patients not committed to medication have PTH levels more than committed patients.

Table 6

Independent sample T-test for the testing difference in PTH level in patients on dialysis inpatient not committed in take medication more than in patients committed

Intervals of PTH testpg/ml	Group statistics					T-test for equality of means	
	Commitment in take medication	N	%	Mean	S. D	t-value	P-value
less than 150	Committed	118	11.9	93.47	38.585	-0.843	0.400
	Not committed	30	3	100.13	38.832		
150 – 300	Committed	137	13.9	224.08	45.273	-1.287	0.201
	Not committed	60	6.1	215.63	41.062		
300 – 600	Committed	128	13	437.53	80.907	-.729	0.467
	Not committed	159	16.2	444.57	82.727		
more than 600	Committed	106	10.7	1042.2	438.7	-2.811	0.005
	Not committed	250	25.2	12035	607.6		
Total respondent	Committed	632	49.5	291.53	157.335	-28.19	0.000
	Not committed	356	50.5	1155.49	566.89		

As shown in the table (6) 50.5% of participants are non adherence in take medication, and the highest percent in participants have PTH level more than 600 pg/ml, T- test done found that there is no significant differences for the first three intervals of PTH (less than 150, 150 – 300, and 300-600), where the values of (P =0.400, 0.201 and 0.467) for each respectively, which higher than the confidence value ($\alpha \leq 0.05$).

Meanwhile the results showed that there is significant differences for the last intervals of PTH level (more than 600), where the values of (P-value=0.005), which lower than the confidence value ($\alpha \leq 0.05$), and when test done on all respondent found that p = 0.000 and this lower than confidence value (p= 0.05). this result accept hypothesis that patients not committed in medication have PTH more than committed .

3.13 Independent sample T-test for testing if the SPTH in a patient less than 40 years old is higher than patient more than 40 years old

RQ 6: Is the SPTH in a patient less than 40 years old higher than in a patient more than 40 years old?

Hypothesis 6: patients less than 40 years old have a PTH level more than patents older than 40 years.

Table 7

Independent sample T-test for testing if the SPTH in a patient less than 40 years old is higher than patient more than 40 years old

Intervals of PTH test pg/ml	Group statistics					T-test for equality of means	
	Age	N	%	Mean	S. D	t-value	P-value
less than 150	Less than 40	22	2	98.40	36.313	2.356	0.126
	More than 40	126	12.8	84.35	45.416		
150 – 300	Less than 40	29	2.9	225.97	42.501	0.589	0.557
	More than 40	168	17	220.74	44.450		
300 – 600	Less than 40	48	4.9	445.88	88.117	0.422	0.674
	More than 40	239	24.2	440.07	80.574		
more than 600	Less than 40	101	10.2	1232.92	663.143	1.468	0.144
	More than 40	255	25.8	1124.82	522.197		
Total respondent	Less than 40	200	20	770.58	673.814	4.128	.104
	More than 40	788	80	560.26	522.197		

According to the data in the table (7), 80% of participants were more than 40 years old, and 20% of a participant were less than 40 years old, the mean of PTH for the all group of intervals of PTH higher in participant less than 40 years .and no significant difference between age and PTH level as t test result for all respondent and also after categories according to PTH level .

3.14 Pearson correlation test to find the relationship between weight and PTH level among end-stage renal disease

RQ7: Is there a relationship between weight and PTH level among end-stage renal diseasepatients?

Hypothesis 7: there is a positive relationship between PTH level and weight.

Table 8

Pearson correlation test to find the relationship between weight and PTH level among end-stage renal disease

Intervals of PTH test pg/ml	N	%	Weight Pearson Correlation	Sig. (2-tailed)
less than 150	148	15	-0.192*	0.02
150 – 300	197	19.9	-0.052	0.071
300 – 600	287	29	-0.015*	0.024
more than 600	356	36.1	-1.133*	0.012
Total respondent	988	100	-0.063 *	0.047

*Correlation is significant at the 0.05 level (2-tailed).

Pearson correlation test was done to find if the relationship between weight and PTH found cleared a significant negative correlation between PTH and weight for the overall sample ($p = 0.047$), the P-value was lower than the confidence value ($\alpha \leq 0.05$). when level of PTH categorized the results cleared that there is significant correlation between PTH and weight for all intervals where the P-value is lower than the confidence value ($\alpha \leq 0.05$), this negative correlation in the study rejects the 7 hypotheses talked that positive correlation between weight and PTH. these results said that low-weight patients have more level of PTH.

3.15 Pearson correlation test to find the relationship between ferritin and PTH level among end-stage renal disease

RQ 8: Is there a relationship between ferritin and PTH level among end-stage renal disease patients?

Hypothesis 8: negative correlation between PTH and ferritin.

Table 9

Pearson correlation test to find the relationship between ferritin and PTH level among end-stage renal disease

Intervals of PTH test pg/ml	N	Ferritin Pearson Correlation	Sig. (2-tailed)
less than 150	148	-0.112	0.174
150 – 300	197	-0.167*	0.019
300 – 600	287	-0.06	0.314
more than 600	356	-0.0108*	0.041
Total respondent	988	-0.027	0.395

* Correlation is significant at the 0.05 level (2-tailed).

Pearson correlation test is done to find if their a relationship between ferritin and PTH. The Results in table (9) cleared that; the P-value =0.395 was higher than the confidence value ($\alpha \leq 0.05$). when the level of PTH was categorized the results cleared that there is no significant correlation between PTH and ferritin for two intervals: (less than 150, 300– 600), where the P-value was higher than the confidence value ($\alpha \leq 0.05$) for each, meanwhile there a significant negative correlation between PTH and ferritin for PTH interval (150-300, and more than 600), where the P-value lower than confidence value ($\alpha \leq 0.05$). this result rejects the hypothesis for the sample and is accepted for categories according to PTH from 150-300 and more than 600 pg/ml. these results reflect that patients who have low serum ferritin have more level of PTH.

3.16 Pearson correlation test to find the relationship between HGB and PTH among end-stage renal disease

RQ 9: Is there a relationship between hemoglobin and PTH level among end-stage renal disease?

Hypothesis 9: negative correlation between PTH and hemoglobin (HGB).

Table 10

Pearson correlation test to find the relationship between hemoglobin and PTH level among end-stage renal disease

Intervals of PTH testpg/ml	N	HGB Pearson Correlation	Sig. (2-tailed)
less than 150	148	0.007	0.929
150 – 300	197	-0.12	0.093
300 – 600	287	-0.07*	0.039
more than 600	356	-0.099*	0.034
Total respondent	988	-0.136**	0.000

** Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Pearson correlation test is done to find the relationship between HGB and PTH The table shows in table (18) cleared that there is a significant negative correlation between PTH and HGB for the overall sample; the (P-value0.000) was lower than the confidence value ($\alpha \leq 0.01$). when the level of PTH was categorized the results cleared that there is a significant correlation between PTH and HGB for categories 300-600 and more than 600 pg/ml which p value0.039 and 0.34 respectively, where

the p-value lower than the confidence value ($\alpha \leq 0.05$). also, there is no significant correlation for categories less than 150 and from 150-300 pg /ml which p -values = 0.929 and 0.093 respectively where the P-value was higher than the confidence value ($\alpha \leq 0.01$) for each. this result accepts the hypothesis that negative correlation between PTH and HGB.

Chapter Four
Discussion and Conclusion

4.1 Introduction

SHPT is a major concern among ESRD patients, and early detection and management can help patients with CKD reduce the side effect of mineral and bone metabolism abnormalities. Early detection and treatment of SHPT in ESRD patients may potentially help to reduce the advancement of the disease's cardiac, Soft-tissue, and vascular calcification, cardiovascular disease, and calcific uremic arteriolopathy consequences [64] [65] [66].

Cardiovascular disease is the leading cause of death in dialysis patients, which may be associated with increased coronary artery calcification [67] [68] [69].

Excess vascular calcification (especially coronary artery calcification) in ESRD patients may be caused by SHPT, hyperphosphatemia, positive net calcium, phosphate balance, calcium intake, and high calcium phosphate product. Unfortunately, even in very young dialysis patients, coronary artery calcification can be noticed [68] [69].

As a result, people with ESRD should be evaluated regularly. mineral and bone metabolism diseases, such as Early identification and therapy of these diseases, as well as SHPT should be used as a key metric among these individuals [53].

4.2 Description of participants' characteristics

A study taken by a convenient sample and they were taken from governmental and private hospitals in the west bank 988 respondents were included in this study. The number and percentage of males 60.2 % are higher than females 39.8% respectively. most respondents age in the sample located in both intervals (41-60), (61-80) by percent 39% and 37.4 % respectively, and the mean of age 54.4 years. The mean of respondents' weight reached 75.7 kg SD 16.146, most of the patients located in weight interval (61-80) which presented 47.1%, the second percentage was for respondents interval (more than 80 kg) which presented 37.8%, while only 15.2% of respondent were under 60 kg.

The number and percentage of diabetics 48.6 % were lower than that of non-diabetics 51.4%. And the percentage of the patient who has HTN was 78.6% higher than

participants who didn’t have HTN 21.4%, 39% of the sample have both DM and HTN, and when categorized into 4 categories according to PTH level, most of the participants with DM and HTN located in patients who have PTH level more than 300 pg/ml.

All of the respondents are on renal replacement therapy (hemodialysis and peritoneal dialysis), with the highest percentage on hemodialysis (HD) (91.9) % and patients of peritoneal dialysis (PD) 8.1%.

In our sample the leading cause of renal failure is hypertension (HTN) by a percent 51.9%, then diabetes (DM) by percent 29.2%, while the other causes for renal failure only 18.9% of the sample .and according to how much they are on renal replacement therapy (compliance on dialysis) 3.8 years. the mean of all respondents, and how much the visit nephrologist 0.89 visit the mean for the sample.

According to laboratory investigation for the sample hyperparathyroidism, the mean for PTH was 602.8 pg/ml and SD 551 while the maximum level up to 500pg/ml [56]. 65.1%of respondents have serum PTH of more than 300 pg /ml. 45.5% of respondents have a normal range of phosphorous, while the normal range is 3.5 to 5.5 mg/dL (1.13 to 1.78 mmol/L) [59], and 39.6 % of respondents have hyperphosphatemia the mean of serum phosphorous for the sample is 6.1 mg/dl. Also, 59.7% of participant has a normal range of serum calcium while normal range (8.4 to 9.5 mg/dL .10 to 2.37 mmol/L) [59]. And 20.3% of participants have serum calcium lower than the normal range and 19.9 % more than the normal range of serum calcium, 24.4% of participants have an HGB level of less than 9 g/dl (anemia) while the normal range for HGB is 11-12 g/dl [98][99]. also, 20.7% of participants have serum ferritin of less than 200 ng/ml and 44.9% have serum ferritin of more than 600 ng/ml while the normal range for ESRD is more than 500 ng/ml [57].

The medication presented in the result chapter in the table (5) in the annex for controlling calcium and phosphorous in blood has to effect on PTH levels.91.9 % of participants take alfacalcidol (one alfa 0.25, 0.5, 0.75, and 1mic), and 58% of participants take a calcium supplement (calcium carbonate 600mg) while 1.4% of participants given calcium glucagunate IV because they have severe hypocalcemia. Only 5.4% of participants take phosphate binder Calcium acetate (Phoslo 667 mg) because this medication is not available in the governmental hospital and in, we have

only one private hospital using this medication, finally, 22.3 % of participants take Sevelamer carbonate 800 mg (Renagel) and this medication also the type of phosphate binder and this medications are not available continuously in government hospitals, this factor affects on PTH level in the patients.

In our study, we found that 50.2% of participants didn't take medication for controlling PTH as prescribed by the nephrologist.

The first line of treatment should be medical, in accordance with the defined sequence of pathophysiological events. Patients with CKD stages 3 to 5 who have 25(OH) deficit or insufficiency should be treated according to general population guidelines(KDIGO 2017)[59] [70].

The sample is convenient from all west banks and we have different governorates, we note that the highest percentage of respondents were from Nablus about 34.1%, then Ramallah and Jenin, with 15.8% and 14.3% respectively, other governorates have only 10% or less of respondents. At the level of intervals according to PTH level, most of hospital have percentage more than 60% of patients have PTH level more than 300 pg /ml. we note that most respondents concentrated in the interval a > 600 pg /ml except NNUH and Jenin hospital highest percent of participants located in interval 300-600 pg/ml.

4.3 Prevalence of SHPT in ESRD patients

Secondary hyperparathyroidism is a common issue in patients with renal disease. This condition has a significant impact on dialysis patient mortality and morbidity.

988 patients were included in the study from 10 centers of dialysis, this sample represents 63% of west bank ESRD patients. In our sample serum, PTH measured Q 6 months regularly, found the prevalence of SHPT among ESRD 65.1% of respondents have serum PTH more than 300 pg/ml, based on the normal range for serum PTH in renal failure patients up to 500 pg /ml according to KDIGO association, the prevalence of SHPT reached to 43.7%. also, the patient who has a critical situation (more than 600 pg/ml) reached 36.1%, was also found.

There are many studies done in the world on the prevalence of SHPT among ESRD patients and most of these results are approximately the same as the result of this study, all studies found more than 50% have SHPT.

In 2018 study done in India find a high prevalence of secondary hyperparathyroidism, 66.6 % of patients with PTH levels over 300pg/ml, 83% of the patients were found to be hypocalcemia and 75% of the patients were found to be having abnormal phosphorous levels [60]. Also, another study has done in India by Chiranjee Lal Dayma in 2019 and this study for measuring the prevalence of secondary hyperparathyroidism in chronic renal failure in the Hadoti region, this study found 72% of patients have SHPT. In hyperparathyroidism patient's serum calcium level was low and the difference was highly significant and also found there is a negative correlation between serum PTH and serum calcium level. In hyperparathyroidism patients' serum phosphate level was high and the difference was highly significant and was a positive correlation between serum PTH and serum phosphorous levels [51].

In Argentina Walter G. Douthat and his colleagues were done a study in 2013 and also for measuring the prevalence of SHPT among dialysis patients and they found 54.6% of patients had PTH more than 300pg/ml, 21.1% displayed acceptable PTH levels (150-300pg/ml). 24% had PTH <150 pg/ml. PTH >600pg/ml was present in 28.3%, and 13.3% had values >1000pg/ml. 51.6% of patients had adequate levels of calcium (8.4-9.5mg/dl), and 51.6% had adequate phosphorus (3.5-5.5mg/dl) [48].

In a 2003 study done in the USA by Ali Owda talked about the prevalence of SHPT among ESRD 78% of the patients had PTH above 200 pg/ml, 19% had PTH within the accepted normal range, while 3% had a level below 100pg/ml [46].

In Jordan in 2015 Ayham Haddad have a study about the prevalence of SHPT and his study was done on 276 patients in 3 royal medical services centers, and he also found a high percentage (77.5%) of participants have SPTH with an average parathyroid hormone level of 887.1pg/ml. The other remaining participants have acceptable average parathyroid hormone levels for hemodialysis patients 127.7pg/ml 13.4% [53].

Additionaly , in systematic review study in 2015 by Elizabeth Hedgeman concluded that SHPT prevalence in dialysis populations (PTH > 300 pg/mL) ranged from 30 to 49 % in Europe and Australia, while the prevalence in dialysis populations in the Americas (USA, Canada) was estimated at 54 %. And Within Asia, prevalence estimates for SHPT (PTH > 300 pg/mL) were only identified for India (28%) and Japan (11.5%) [47].

4.4 Discussion of diabetes and PTH

In this study, 48.6% have diabetes with serum PTH greater than 300 pg/ml are and 51.4 % non-diabetic. This study by independent T- test to found non diabetic patients have PTH level more than diabetic, where the P-value was lower than the confidence value ($\alpha \leq 0.01$).

The earliest study in 1981, 1990, and 1997 respectively shows that diabetic patients had significantly lower parathyroid hormone (PTH) levels than nondiabetic patients [71] [72] [73]. Also, in 2008 in Saudi Arabia Hamid Nasri, and Soleiman Kheiri There were significantly lower values of serum PTH, ALP, and dialysis adequacy among diabetic than non-diabetes HD patients [74]. In 2003 study was done in the USA by Ali Owda and in 2016 in Iran by Fatemeh Hayaati shows in that’s no statistically significant difference in the prevalence of secondary hyperparathyroidism between diabetic and non-diabetic patients [46] [52].

In India, in 2019 Chiranjee Lal Dayma's secondary hyperparathyroidism in diabetic patients is 66%, and in non-diabetic patients is 73% [51]. Patients with diabetes who are on dialysis had lower PTH levels than those who do not have diabetes [75].

It is widely recognized that changes in mineral metabolism can lead to disturbances in the metabolism of glucose and glucose intolerance, both of which can affect mineral metabolism. Poor calcium, phosphorus, and magnesium absorption has been linked to poorly controlled diabetes mellitus, examined PTH secretion in diabetes patients with various levels of metabolic control, and found demonstrated that following acute stimulation, individuals with poor metabolic control secreted less PTH than well-controlled diabetic and normal subjects [76].

PTH and magnesium interact intricately, preventing both the release and function of this hormone. While chronic severe hypomagnesaemia has a negative impact and is the

only known cause of clinical hypoparathyroidism, acute hypomagnesaemia promotes PTH secretion. Moreover, hypomagnesemia is linked to diminished PTH activity on target tissues, possibly as a result of a functioning adenyl cyclase system impairment [76] [77].

This study confirmed that serum PTH levels were lower in diabetic hemodialysis patients than in non diabetic patients, but it also demonstrated that poor glycaemic control further decreased serum PTH levels without the administration of any active forms of vitamin D, whereas betterglycaemic control increased serum PTH levels [78].

4.5 Discussion of gender and PTH

In our sample 60.2% of respondents are males and only 39.8% are females, which approximately similar to previous studies [46] [47] [48] [49] [51] [53].

independent T-test was done to find if their different occurrence of hyperparathyroidism between gender, found that's no significant relationship between gender and hyperparathyroidism.

Indridason finds in his study the association between gender and PTH response. found that PTH suppression was less in women than in men [79].

But Bures find the different result from international studies like

Indridason et al [79]. showed that among dialysis patients more women were diagnosed with SHPT than men [80].

4.6 Discussion of period on dialysis (dialysis adherence) and PTH

according to data 73.4% of participants they are on dialysis for less than 5 years and 26.6 % they are on dialysis for more than 5 years.

In this study there is a significant difference in the sample at all which ($p = 0.000$) and this is lower than the confidence value ($\alpha = 0.05$), while the sample was categorized for intervals, for intervals of PTH (less than 150, 150 – 300pg/ml), where the values of (P-=0.449 and 0.731) for each respectively, which higher than the confidence value ($\alpha \leq 0.05$). Meanwhile, the results showed that there are significant differences for the last intervals of PTH level (300-600 more than 600pg/ml), where the values of (P-

=0.029, p= 0.001)respectively, which are lower than the confidence value (α≤0.05), also the mean of PTH for last interval of PTH (more than 600) has a significant difference in the mean, these result shows that patient who has on dialysis more than 5 years have hyperparathyroidism or more risk to become hyperparathyroidism more than a patient who's been on dialysis for less than 5 years.

There no previous study founded talked about years of dialysis effect on PTH level.

4.7 discussion of committed on medication and PTH

Our study shows 50.5% of the participant are non-adherent to medication responsible for the control of calcium and phosphorous and this affect PTH result. 49.5 % of the participant are adherent to their medication, and when the test done on all participant in the sample found p = 0.000 and this lower than confidence value (α= 0.05) also the mean of PTH for last interval of PTH (more than 600) has a significant difference in the mean.

Most SHPT therapy challenges are caused by factors that are medical and related to patients. A major issue is the lack of recommendations that can identify a specific target for PTH with a high level of evidence. Furthermore, it is necessary to note that the existence of many guidelines and associated targets on other continents may lead to misunderstandings and worsen medical noncompliance in the treatment of CKD-MBD [81] [82] [83].

nearly 50 % of patients with chronic illnesses, such as those receiving dialysis or post-kidney transplantation, showed noncompliance with medications and other parts of treatment. Young age, socioeconomic level, family support, the complexity of medical therapy, patient attitudes and motivation, and others may have an impact on drug compliance. According to reports, the most frequent reason why medications don't work as intended and treatments don't work as intended is low compliance. Poor compliance frequently results in more frequent and frequently unneeded tests, dosage adjustments, modifications to the treatment plan, and visits to the emergency room. Recently, it was recommended to maintain serum phosphorus levels at less than 5.5 mg/dL. More than 60% of dialysis patients would be deemed noncompliant with phosphate binders, dietary phosphorus limits, or both as mahmoud Adham said [84].

Additionally, bame discovered that 50% non compliant prescribed medication, and 2% noncompliant with potassium [85].

The phosphorus level is related to dietary and pharmaceutical compliance. Elevated blood phosphorus levels are undeniably related to high PO4 diets or not taking PO4 binders. In retrospect, these patients weren't non-compliant; they were merely taking the wrong medication. Studies have utilized noncompliance thresholds ranging from 5.5 mg/dl to 7.5 mg/dl [86]. poor drug adherence is a typical reason for treatment failure [87].

Arenas found in his study that poor control of PTH is caused by non-adherence to the treatment, whereas a significant increase in serum PTH levels was noticed in adherent patients after stopped taking medication [88].

Leggat found the percentage of nonadherent dialysis patients may range from 50% to 85%. Low adherence to medications used to treat renal bone diseases is especially concerning because greater levels of intact parathyroid hormone (PTH), phosphorus, and calcium phosphorous product have been linked to higher rates of morbidity and death [89].

4.8 discussion of age and PTH

According to the data, 80 % of participants were more than 40 years old, also 50 % of participants have serum PTH more than 300 pg /ml more than 40 years old also T-test was used to see to compare between(patients more than 40 years old and less than 40 years old) and the level of PTH and According to the data in the table (7) there is a no significant difference for all participant in the sample(p=0.104) these results reflect that no relationship between age and parathyroid level.

Happy Chutia et al. discovered that there is no significant relationship between age and PTH. also, Chi-square bivariate study done in the same cohort, which included serum PTH and Age, similarly revealed that there is no significant relationship between age and PTH [89].

4.9 discussion of relationship between weight and PTH

Pearson test is done to find if their a relationship between weight and hyperparathyroidism. The Results of the study found that there is a significant negative correlation between PTH and weight for the overall sample (p= 0.047), and the P-value was lower than the confidence value ($\alpha \leq 0.05$). these results indicate patient have low weight have a high level of PTH more than patients have high weight.

according to Kovesdy and his colleagues found in a study done in 2007 higher BMI is associated with secondary hyperparathyroidism in patients with CKD who are not on dialysis till now [90].

Komaba H discovered in 2021 that increased PTH level was associated with eventual weight loss, a wasting sign. The link between PTH and weight loss also attempted to clarify why those with high PTH levels have a higher risk of dying. These findings suggest that SHPT may be a significant wasting mechanism and that this pathway may be linked to high PTH levels and dialysis patient mortality [91].

In 2010, Drechsler discovered a relationship between BMI and PTH. Underweight patients had the lowest PTH levels, then by normal weight, overweight, and obese patients. also, as in the study Over three months of course, a 5% decrease in BMI was linked with a 26% reduction in PTH level in the blood, whereas a 5% increase in BMI was associated with an 11% increase in PTH level [92]. also, Obese people have higher levels of serum PTH than non-obese people, and their levels decreased while they lose weight as bell said in his study [93].

4.10 discussion relationship between ferritin and PTH

Pearson correlation test is done to find the relationship between ferritin and secondary hyperparathyroidism among end-stage renal disease conclude that no significant correlation between PTH and ferritin for the sample..these result reflect that no relationship between serum ferritin and PTH.

Happy Chutia, etal find there is no significant association was observed between ferritin and PTH levels. also, Chi-square bivariate analysis in the same study was carried out including serum PTH, ferritin didn't show any relationship between these parameters. More importantly, no correlation was observed between PTH and ferritin [89].

Saki in 2020 and piriccoulgo in 2017 in different studies found They also found a positive significant correlation between ferritin and PTH in these patients [94] [95]. Pawlotsky et al. revealed a positive correlation between serum ferritin and a raise in serum PTH 44–68 levels in patients with iron overload syndrome [96].

Sliem *et al.* reported similar results, that positive correlation between serum ferritin and serum PTH [97]. In addition, Ali *et al.* reported similar results [98].

Keshk R et al found a positive correlation between serum ferritin and serum PTH level [99].

Hagag A, El-Shanshory found there is a negative correlation between serum ferritin and PTH levels [100]. This finding agrees with the results from Belhoul et al [101]. but disagrees with Sleem et al [102]. who found no correlation between these two parameters. As also found by Karimi [103]**.**

5.11 discussion relationship between HGB and PTH

Pearson correlation test to find the relationship between hemoglobin and secondary hyperparathyroidism among end-stage renal disease discovered that significant correlation between PTH and HGB for the overall sample; the P-value was lower than the confidence value ($\alpha \leq 0.01$).

for each these results indicate that a negative correlation between PTH and HGB level.

Happy Chutia found A significant association was founded between PTH and HGB also bivariate analysis was carried out including serum PTH, HGB and found a correlation between HGB and PTH., A reverse correlation was found between PTH and HGB level, which indicates that the variables PTH and HGB level are inversely proportional to each other [89]. which is consistent with the findings of Baradaran and Nasri[104] Sliem et al[97] and Trovato et al[105].

The levels of PTH and HGB were found to have a negative relationship as Gallieni and his colleagues said. Higher bone marrow fibrosis, which can lead to decreased erythropoietin and increased resistance to EPO, could be one reason for low HGB levels or anemia related to SHPT [106].

Calcitriol receptors are expressed on erythropoietin cells, causing erythroid progenitor cells to proliferate and mature. As a result, a calcitriol shortage, which is a cause of hyperparathyroidism, may decrease erythropoiesis. There are also some studies that support an increase in erythrocyte osmotic fragility as a result of high PTH levels in dialysis patients, resulting in low HGB levels [107].

Goicoechea found in his study that PTH levels were negatively connected with HGB levels at baseline in a case series study, and a bigger decrease in PTH was associated with a greater increase in HGB [108].

According to the findings of Carlo M, et al, adequate regulation of SHPT is followed by an improvement in anemia and a decrease in ESA mean dosages. These findings are most likely owing to a large decrease in PTH levels, implying that PTH plays an important role in conditioning anemia and resistance to Erythropoietin-stimulating agent action. While more research is needed to see if PTH lowering is causally associated with anemia improvement, our findings support PTH assessment as a potentially modifiable factor in anemic dialysis patients [109].

Concerning the correlation between PTH and serum HGB the significant negative correlation between PTH and serum HGB Keshk R, et al [99]. This was in agreement with the study by Sliem *et al*, who also found a significant negative correlation between PTH and serum HGB among hemodialysis patients [97].

Furthermore, Penne et al. found a statistically significant connection between PTH and serum HGB in hemodialysis patients [110]. Even though Adhikary et al. found a modest negative connection between HGB and PTH in hemodialysis patients, it was not statistically significant [111].

On the other hand Memon, et al said Greater PTH levels were associated with higher hemoglobin levels among diabetics but not non-diabetics in a large community-based CKD population. Additional research into the processes underlying this link is needed [112].

4.12 Conclusion

The study showed that SHPT is common among patients with end-stage renal disease. The most complications of SHPT are mineral and bone metabolism disorders and cardiovascular diseases. Thus, early detection and treatment of SHPT may control these complications.

4.13 Summary of the finding

1. 65.1% the percentage of patients who have a PTH level of more than 300 pg/ml, the mean of sample for PTH test reached 602.8 pg/ml ± 551. With mean of calcium of 8.8 mg/dl and a mean of phosphorous of 6.5 mg/dl.
2. Diabetics patients with PTH levels lower than non diabetic.
3. 39.9 % of males have a PTH level of more than 300 pg/ml meanwhile 25.2 % for female with no significant difference.
4. Patients on dialysis for more than 5 years have a PTH level more than patients with less than 5 years of adherence on dialysis.
5. Age didn’t have any influence on PTH level.
6. Negative relationship between PTH level and weight.
7. No relationship between ferritin and PTH level.
8. Negative relationship between HGB and PTH level.

4.14 Strength and Limitation of the study

1. The strength of the study is that the convenient sample was taken from the west bank.
2. One of limitation that Alia hospital excluded from the sample because they didn’t do PTH tests regularly.
3. Medication in a governmental hospital isnot given regularly.
4. Some patients didn’t give accurate data.
5. Because its electronic data may have percent of error in entering data by medical team.

4.15 Recommendation

1. There is a need for a nephrologist to follow up with patients in each center at least visit per month.
2. For ministry of health and nephrologist to apply protocol for PTH test level when patient become stage 3 in CKD.
3. There is a need for further research to detect other medical, social. financial factor that affects PTH level, and researches to reassure compliance patients on medications.
4. There is a need for a clear strategy to improve PTH levels among renal failure patients, especially in the government hospital.
5. There is a need for media development, brochures, and educational sessions in simple language to educate patients about hyperparathyroidism and their complications.
6. It's important for nephrologists and detritions to work together to overcome and control the PTH level.
7. For MOH, it's important to provide medications regularly, especially phosphate binders and calcium supplements.
8. Increase knowledge and awareness for patients serious about hyperparathyroidism and its complications.

List of abbreviation

Abbreviation	Meaning
CKD	Chronic kidney disease
ESRD	End stage renal disease
PD	Peritoneal dialysis
HD	Hemodialysis
GFR	Glomerular filtration rate
RRT	Renal replacement therapy
HTN	Hypertension
DM	Diabetes mellitus
HIV	Human immunodeficiency virus
GBD	Global burden of disease
WHO	World health organization
G1	Stage 1 kidney disease
G2	Stage 2 kidney disease
G3	Stage 3 kidney disease
G4	Stage 4 kidney disease
G5	Stage 5 kidney disease
NIDDK	National institution of diabetes and digestive and kidney
USRDS	United state renal data system
SHPT	Secondary hyperparathyroidism
PTH	Parathyroid hormone
S.PTH	Serum parathyroid hormone
S.PO4	Serum phosphorous
NNUH	An-najah national university hospital
HGB	Hemoglobin
Ca	Calcium
PO4	Phosphorous
S.CREAT	Serum creatinine
BUN	Blood urea nitrogen
KIDGO	Kidney Disease Improving Global Outcomes
IRB	institutional review board
NSAID	Non- steroidal anti inflammatory drug
ACR	Albumin to creatinine ratio
MBD	Mineral bone disorder

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Appendices

Appendix A

Classification of CKD based on the presence or absence of systemic disease and the location of the pathologic-anatomic finding:

Disease	Examples of systemic diseases affecting the kidney	Examples of primary kidney diseases (absence of systemic diseases affecting the kidney)
Glomerular diseases	Diabetes, systemic autoimmune diseases, systemic infections, drugs, neoplasia (including amyloidosis)	Diffuse, focal or crescentic proliferative glomerulonephritis; focal and segmental glomerulosclerosis; membranous nephropathy, minimal change disease
Tubulointerstitial diseases	Systemic infections, autoimmune, sarcoidoisis, drugs, urate, environmental toxins (lead, aristolochic acid), neoplasia (myeloma)	Urinary-tract infections, stones, obstruction
Vascular diseases	Atherosclerosis, hypertension, ischemia, cholesterol emboli, systemic vasculitis, thrombotic microangiopathy, systemic sclerosis	ANCA-associated renal limited vasculitis; fibromuscular dysplasia
Cystic and congenital diseases [21], [22]	Polycystic kidney disease, Alport's syndrome, Fabry's disease	Renal dysplasia, medullary cystic disease, podocytopathies

Appendix B

Data collection tools used in the study

An-Najah National University

Faculty of Graduated Student

secondary hyperparathyroidism among end stage renal disease in west bank

Prepared by :Osaid Fayez Marie

Supervisor :

Dr: Mariam Al-tell

Dr: Zakaria Hamdan (nephrologist)

This form for data collection tools :

This tools contain four section

This tools only will be top secret and for scientific usage and will be discarded after completion of purpose.

Section 1:

Demographic data :

Patient file number : ----------

Sex : male female

Weight ----------

Age : below 19 20-39 40-59

60-79 above 80

section 2:

medical history

DM HTN cardiac problems osteoporosis

CAUSE OF DIALYSIS :

DM HTN poly cystic kidney

medications atonic bladder

Other causes ----------

Type of dialysis : hemodialysis peritoneal dialysis

Duration on dialysis :----------

Monthly visit for nephrologists : yes no

Previous operation in parathyroid gland :yes no

Section 3

Hematology and biochemistry labs result :

HGB	SERUM CREATININE	SERUM BUN	SERUM PTH	SERUM CALCUIM	SERJUM PHOS	SERUM ALBUMIN	FERRITIN

SECTION 4

Medication taken for patient for hyperparathyroidism

No	Medication name	Dose	frequency
1			
2			
3			
4			
5			

Medication taken by : patient himself family nurse

Patient commitment in taken medication : yes no

Thanks

Appendix C

IRP approval

An-Najah National University
Faculty of medicine Sciences Health
Institutional Review Board

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

Ref:Mas. Feb. *2021/14*

IRB Approval Letter

Study Title:

"Secondary Hyperparathyroidism Among End Stage Renal Disease in West Bank"

Submitted by:
Osaid Fayez Husni Marie

Supervisor:
Mariam Al-tell , Zkaria Hamdan

Date Approved:
16th Feb. 2021

Your Study Title **"Secondary Hyperparathyroidism Among End Stage Renal Disease in West Bank"** viewed by An-Najah National University IRB committee and was approved on 16th Feb. 2021

Hasan Fitian, MD

IRB

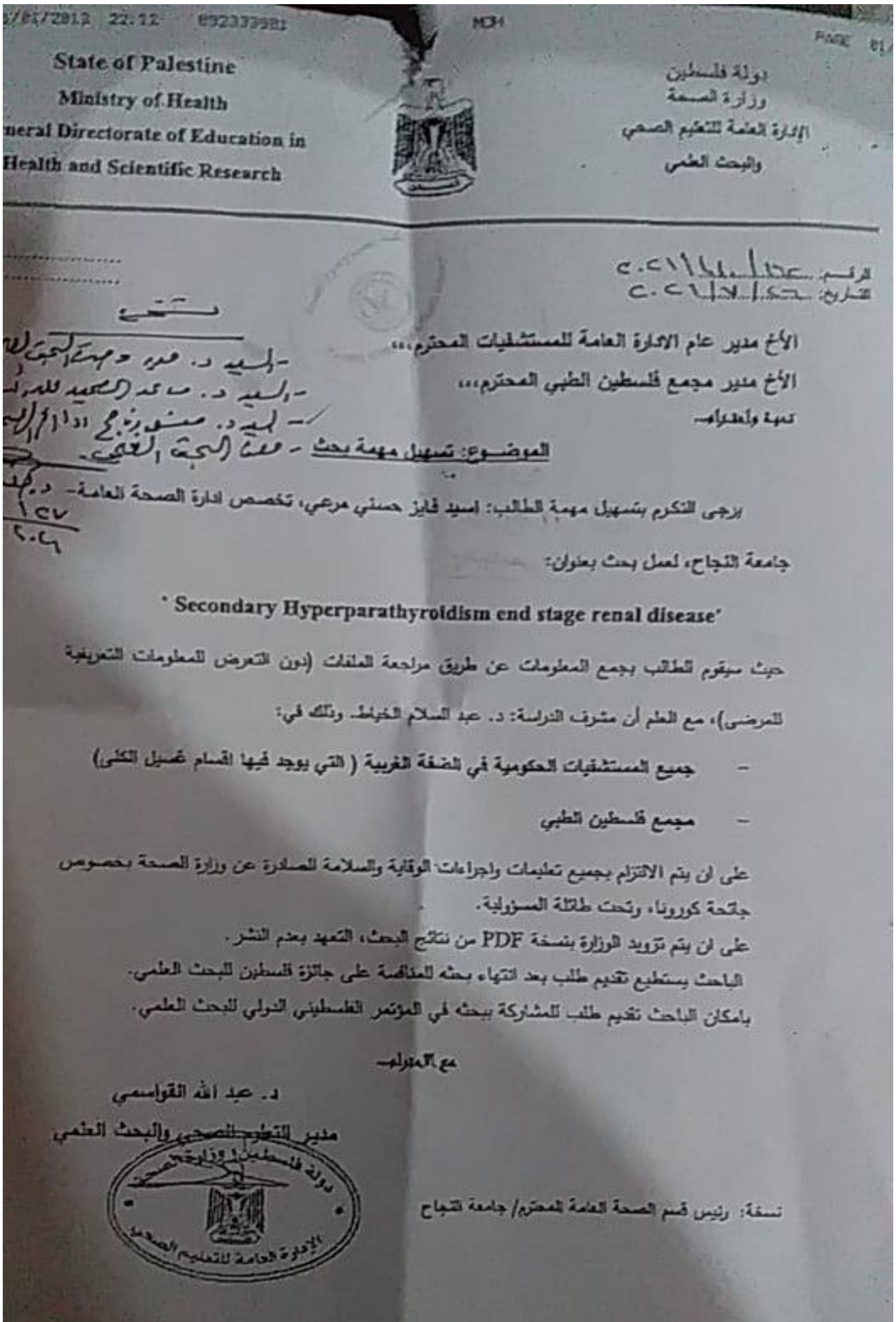
IRB Committee Chairman
An-Najah National University

نابلس - ص.ب 7 أو 707 || هاتف 09)2342902/4/7/8/14)(970) || فاكسيل 2342910 (09) (970)

Nablus - P.O Box :7 or 707 | Tel (970) (09) 2342902/4/7/8/14 | Faximile (970) (09) 2342910 | E-mail : hgs@najah.edu

Appendix D

ministry of health approval for data collection from hospitals



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State of Palestine
Ministry of Health
neral Directorate of Education in
Health and Scientific Research

دولة فلسطين
وزارة الصحة
الإدارة العامة للتعليم الصحي
والبحث العلمي

الرقم: [illegible]
التاريخ: [illegible]

الأخ مدير عام الادارة العامة للمستشفيات المحترم،،،
الأخ مدير مجمع فلسطين الطبي المحترم،،،
تحية واحترام،

الموضوع: تسهيل مهمة بحث

يرجى التكرم بتسهيل مهمة الطالب: اسيد فايز حسني مرعي، تخصص ادارة الصحة العامة-
جامعة النجاح، لعمل بحث بعنوان:

' Secondary Hyperparathyroidism end stage renal disease'

حيث سيقوم الطالب بجمع المعلومات عن طريق مراجعة الملفات (دون التعرض للمعلومات التعريفية للمرضى)، مع العلم أن مشرف الدراسة: د. عبد السلام الخياط. وذلك في:

- جميع المستشفيات الحكومية في الضفة الغربية (التي يوجد فيها اقسام غسيل الكلى)
- مجمع فلسطين الطبي

على ان يتم الالتزام بجميع تعليمات واجراءات الوقاية والسلامة الصادرة عن وزارة الصحة بخصوص جائحة كورونا، وتحت طائلة المسؤولية.
على ان يتم تزويد الوزارة بنسخة PDF من نتائج البحث، التعهد بعدم النشر.
الباحث يستطيع تقديم طلب بعد انتهاء بحثه للمنافسة على جائزة فلسطين للبحث العلمي.
بامكان الباحث تقديم طلب للمشاركة ببحثه في المؤتمر الفلسطيني الدولي للبحث العلمي.

مع الاحترام،

د. عبد الله القواسمي
مدير التعليم الصحي والبحث العلمي

نسخة: رئيس قسم الصحة العامة المحترم/ جامعة النجاح

ll

Appendix E

consent from for approval from patients for collection data

بسم الله الرحمن الرحيم

الموضوع : طلب الموافقة على الانتساب في دراسة للحصول على درجة الماجستير

أنا الطالب اسيد فايز حسني مرعي صاحب الرقم الجامعي 11850974 وهوية رقم 851986224 ادرس ماجستير في جامعة النجاح الوطنية تخصص صحة عامة , و اعمل في وزارة الصحة – مستشفى الشهيد ياسر عرفات –سلفيت-, وقد أنهيت متطلبات التخصص النظرية وبقي رسالة الماجستير وقد اخترت الرسالة بعنوان

فرط نشاط غدد الجارات درقية في مرضى الفشل الكلوي المزمن

أرجو من حضرتكم الموافقة على الانتساب في هذه الدراسة للحصول على المعلومات من اجل الدراسة

علما أن هذه المعلومات سرية وستكون لأغراض البحث العلمي فقط وسيتم التخلص منها فور الانتهاء من الدراسة, راجيا منكم الموافقة.

ولكم جزيل الشكر والعرفان

الطالب : اسيد فايز مرعي

توقيع المشترك

Appendix F

Distribution of respondent's percentage according to their demographic data

	Variables	No.	%
Age	Less than 20	24	2.4
	21 – 40	187	18.9
	41 – 60	385	39.0
	61 – 80	370	37.4
	More than80	22	2.2
	Mean± SD	54.4 ± 16.107	
Gender	Male	595	60.2
	Female	393	39.8
Weight	40 or less	12	1.2
	41 – 60	138	14.0
	61 – 80	465	47.1
	More than 80	373	37.8
	Mean ± SD	75.7 ± 16.146	

Appendix G

Distribution of respondent's percentage and mean according to medical overview data

	All		Distribution according PTH intervals							
			<150		150-300		300-600		>600	
	No.	%	No.	%	No.	%	No.	%	No.	%
DM	480	48.6	83	8	104	11	150	15	143	14
HTN	777	78.6	114	14.7	151	19.4	227	29.2	285	36.7
HD	908	91.9	125	13.8	180	19.8	264	29.1	339	37.3
PD	80	8.1	23	28.8	17	21.2	23	28.8	17	21.2
Cause of renal failure										
DM	288	29.2	57	5.8	70	7.1	93	9.4	68	6.9
HTN	513	51.9	61	6.2	89	9	149	15.1	214	21.7
Others(polycystic kidney , nephritis , medication over use, etc)	187	18.9	30	3	38	3.8	45	4.6	74	7.5
Mean of Years on dialysis and SD	3.8 ± 2.99		3 ± 2.3		3.6 ± 3.1		3.6 ± 2.7		4.5 ± 3.3	
Mean of No. of visit and SD	0.89 ± 0.307		0.93± 0.263		0.94 ± 0.230		0.94 ± 0.230		0.81 ± 0.389	

Appendix H

Mean and SD of laboratory investigation data for participant

Lab test	All respondents		Distribution according PTH intervals							
			<150		150-300		300-600		> 600	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PTH	602.8	551	94.8	39	221.5	44	441	82	1155.5	567
Calcium	8.8	1	9.2	1.1	8.9	1	8.7	1	8.7	1.1
Phosphorous	6.1	14.2	8.6	1.5	5	1.7	5.5	4.5	6.2	5
Albumin	4	0.5	3.7	0.6	3.9	0.5	4	0.5	4.1	0.5
HGB	10.4	2	10.7	2	10.6	2	10.5	2	10.1	2
Ferritin	641.6	541	794.7	651	627.5	456	629.9	546	595.4	520

Appendix I

frequencies and percent of participant according to laboratory investigation

Labe test	Category of serum Ca	No	%
Ca	Less than 8 mg/dl	201	20.3
	8.1 - 9.5 mg /dl	590	59.7
	More than 9.5 mg/dl	197	19.9
	Total	988	100.0
Pho4	Category of serum pho	No	%
	Less than 3.5 mg /dl	147	14.9
	3.6 - 5.5 mg /dl	450	45 .5
	More than 5.5 mg /dl	391	39.6
	Total	988	100.0
HGB	Category of HGB	No	%
	Less than 9 g/dl	241	24.4
	9.1 – 12 g/dl	581	58.8
	More than 12 g/dl	166	16.8
	Total	988	100.0
Ferritin	Category of serum ferritin	No	%
	Less than 200 ng/ml	205	20.7
	201 – 600 ng/ml	339	34.3
	More than 600 ng/ml	444	44.9
	Total	988	100.0
Albumin	Category of serum albumin	No	%
	Less than 3 g/dl	48	4.9
	3.1 – 4 g/dl	490	49.6
	More than 4 g /dl	450	45.5
	Total	988	100.0

Appendix J

Distribution of respondent's according to medication that have effect on PTH level.

Medication		All respondent In the sample		Distribution according PTH intervals <150		151 – 300		301 - 600		> 601	
Name of drug	Frequency	No.	%	No.	%	No.	%	No.	%	No.	%
Alpha0.25mcg	1 * 1	399	40.4	67	6.8	86	8.7	112	11.3	125	12.6
	1 * 2	248	25	37	3.7	40	4	82	8.3	89	9
	1 * 3	6	0.6	1	0.1	2	0.2	3	0.3	0	0
Total		653	66.1	105	10.6	128	13	197	19.9	21	21
Alpha 1mcg	1* 1	232	23.5	29	2.9	48	4.8	66	6.7	89	9
	1* 2	23	2.3	2	0.2	2	0.2	6	0.6	13	1.3
Total		255	25.8	31	3.1	51	5	72	7.3	102	10.3
Calcium600mg	1*1	37	3.7	5	0.5	13	1.3	11	1.1	8	0.8
	1*2	99	10	18	1.8	21	2.1	33	3.3	27	2.7
	1*3	240	24.3	28	2.9	39	3.9	74	7.5	99	10
	2*2	49	4.9	13	1.3	11	1.1	12	1.2	13	1.3
	2*3	152	15.4	19	1.9	33	3.3	54	5.5	46	4.7
Total		577	58	83	8.4	117	11.8	184	18.6	193	19.5
Calcium gluconate 10% IV	Q HD	14	1.4	3	0.3	2	0.2	4	0.4	5	0.5
Total		14	1.4	3	0.3	2	0.2	4	0.4	5	0.5
Phoslo 667 mg	1*1	5	0.5	1	0.1	1	0.1	1	0.1	2	0.2
	1*2	16	16.2	4	0.4	5	0.5	3	0.3	4	0.4
	1*3	15	15.1	1	0.1	6	0.6	3	0.3	5	0.5
	1*4	7	0.7	2	0.2	1	0.1	3	0.3	1	0.1
	2*3	10	1	1	0.1	2	0.2	4	0.4	3	0.3
Total		53	5.4	9	0.9	15	1.5	14	1.4	15	1.5

**Phoslo only given in NNUH hospital because not available in governmental hospital*

Sevelamer 800 mg	1 * 1	11	1.1	0	0	2	0.2	2	0.2	7	0.7
	1 * 2	36	3.6	2	0.2	5	0.5	13	1.3	16	1.6
	1 * 3	115	11.6	13	1.3	18	1.8	27	2.8	57	5.8
	1 *4	27	2.7	2	0.2	1	0.1	10	1	14	1.4
	2*3	31	3.1	2	0.2	14	1.4	4	0.4	11	1.1
Total		220	22.3	19	1.9	40	0.4	56	5.7	105	10.6

Appendix K

Distribution of respondent's percentage according to dialysis center.

Dialysis center	All respondent in the sample		Distribution according PTH intervals							
			<150		151 – 300		301 – 600		> 601	
	No.	N%	No.	N%	No.	N%	No.	N%	No.	N%
Jenin (khalilsalman hospital)	141	14.3	24	17.0	29	20.6	47	33.3	41	29.1
Salfeet (yaserarafat hospital)	30	3.0	4	13.3	5	16.7	10	33.3	11	36.7
Jerico (jerico hospital)	41	4.1	2	4.9	2	4.9	8	19.5	29	70.7
Ramallah (palestine medical comples hospital)	156	15.8	8	5.1	21	13.5	53	34.0	74	47.4
Qalqilya (Darweesh .nazzal hospital)	25	2.5	2	8.0	3	12.0	6	24.0	14	56.0
Tubas(Turkish tubas governmental hospital)	39	3.9	9	23.1	7	17.9	2	5.1	21	53.8
Tulkarm (thabetthabethospital)	94	9.5	23	24.5	19	20.2	21	22.3	31	33.0
Yatta abo alhasanalqasem hospital	24	2.4	0	0.0	2	8.3	6	25.0	16	66.7
Nablus (an-najah national university hospital)	337	34.1	69	20.5	94	27.9	103	30.6	71	21.1
Beit jala (Beit jala governmental hospital alhusain)	101	10.2	7	6.9	15	14.9	31	30.7	48	47.5

جامعة النجاح الوطنية

كلية الدراسات العليا

فرط نشاط غدد جارات الدرقية بين مرضى المرحلة النهائية لغسيل الكلى في الضفة الغربية

إعداد

أسيد فايز مرعي

إشراف

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د. زكريا حمدان

قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في الصحة العامة، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس– فلسطين.

2023

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الملخص

الخلفية: فرط نشاط الغدد الجارات الدرقية الثانوي (SPHT) هو أحد المضاعفات الخطيرة لدى مرضى الفشل الكلوي، ويحدث عند عدم توازن الكالسيوم والفسفور. إنها مسألة مهمة جدًا لأنها قد تؤدي إلى العديد من المضاعفات مثل أمراض القلب والأوعية الدموية والأنسجة الرخوة وتكلس الأوعية الدموية.

الهدف: تهدف هذه الدراسة إلى تحديد مدى انتشار فرط الغدد نشاط جارات الدرقية الثانوي بين مرضى الكلى في المرحلة النهائية في مراكز غسيل الكلى في الضفة الغربية. ولمعرفة ما إذا كان هناك عامل يؤثر على مستويات هرمون الغدد الجارات درقية، علاوة على ذلك، تسليط الضوء على فرط نشاط جارات الدرقية المنتشر بين أطباء الكلى لتقليل المضاعفات التي قد تحدث من فرط نشاط الغدد الجارات درقية.

منهجية الدراسة: أجريت هذه الدراسة الوصفية وتم استخدام التصميم المقطعي الرجعي من خلال مراجعة السجلات الطبية للمرضى الذين يتلقون غسيل الكلى (البريتوني والغسيل الكلوي) في 10 وحدات كلى موزعة في مناطق مختلفة في الضفة الغربية. يتم استخدام اختبار T المستقل لمقارنة المتوسطات واختبار بيرسون للعثور على الارتباط في التحليل بواسطة SPSS.

النتائج: أظهرت نتائج الدراسة أن 65.1% من المرضى لديهم مستوى هرمون الغدد الجارات درقية أكثر من 300 بيكوغرام/مل، بمتوسط 602.8 بيكوغرام/مل ±551، كما وجد أن متوسط الكالسيوم 8.8 ملغ/ديسيلتر ±1 ومتوسط الفسفور 6.5 ملجم / ديسيلتر. فيما يتعلق بالمرضى المصابين بالسكري، وجدت النتائج أن 29.7% منهم كان اختبار هرمون الغدد الجارات درقية أعلى من 300 بيكوغرام/مل وغير المصابين بالسكري كان 35.4%، ووجدت الدراسة أن المرضى غير المصابين بالسكري لديهم مستوى هرمون الغدد الجارات درقية أكثر من مرضى السكري وفقًا لاختبار T مستقل. 39.9% من الذكور لديهم مستوى هرمون الغدد الجارات درقية أكثر من 300 بيكوغرام/مل بينما 25.2% من الإناث كان لديهم نفس المستوى،20.3% من المشاركين لديهم كالسيوم في الدم أقل من 8 ملغ/ديسيلتر و19.9% لديهم مستوى كالسيوم في الدم أكثر من 9.5 ملغم / يوم، 39.6٪ من المشاركين يعانون من فرط فوسفات الدم، أشار اختبار T المستقل إلى عدم وجود اختلاف بين الجنس في مستوى هرمون الغدد الجارات درقية.المرضى الذين يخضعون لغسيل الكلى لأكثر من 5 سنوات لديهم مستوى هرمون الغدد الجارات درقية أكثر من المرضى الذين لديهم أقل من 5 سنوات من الالتزام بغسيل الكلى أيضًا عن طريق استخدام اختبار T المستقل أيضًا، ولم يكن للعمر أي تأثير على مستوى هرمون الغدد الجارات درقية وجدت علاقة سلبية مع وجود فرق كبير بين مستوى هرمون الغدد الجارات درقية والوزن. توجد علاقة سلبية بين مستويات مخزون الحديد وهرمون الغدد الجارات درقية مع عدم وجود فرق معنوي للعينة وفرق معنوي للمريض الذي لديه مستوى هرمون الغدد الجارات درقية أكثر من 600 بيكوغرام / مل. وأخيرا العلاقة السلبية بين مستويات الهيموجلوبين وهرمون الغدد الجارات درقية مع اختلاف ذي دلالة.

التوصيات:يعد فرط نشاط الغدد الجارات الدرقية الثانوي مشكلة خطيرة للغاية لدى مرضى الداء الكلوي بمراحله الأخيرة والذي قد يؤدي إلى العديد من المضاعفات مثل المضاعفات التي تهدد الحياة. من بين مرضى غسيل الكلى، يعد فرط نشاط الغدد الجارات الدرقية الثانوي شائعًا، مما قد يزيد من التأثير على المرضى وأقارب المريض مقدمي الرعاية الصحية. ويجب اتخاذ كافة الطرق مثل تدابير الكشف المبكر

للحد من هذه المضاعفات، والالتزام بغسيل الكلى والتشاور مع إرشادات رعاية أمراض الكلى، وإلهام المرضى لمتابعتها في كثير من الأحيان والالتزام بالأدوية الموصوفة لهم والاختبارات المعملية الروتينية والسيطرة المبكرة على المضاعفات المتوقعة.

الكلمات المفتاحية: فرط نشاط الغدد جارات الدرقية الثانوي، مرض الكلى المزمن، مرض الكلى في المرحلة النهائية، هرمون الغدة الدرقية.