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Body Mass Index (BMI) as Risk Factor for Developing Hypogonadism among Sudanese Patient with Chronic Kidney Disease

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Abstract

Background: CKD beside it is a heterogenous clinical disorders it is the general term use for describing an irreversible loss of kidney function, that develops due to multifactorial etiology over a period of few years, with prevalence rate between 11%-13% globally and 5%-7% locally, so the aim of this study was designed to investigate the association of the serum testosterone in patient with CKD. Methods: The study was conducted at military hospital, Police hospital and kidney transplantation association, case-control study was completed within meantime sex month from November 2017 to April 2018, the study carried out on a total sample of 80 subjects including 40 CKD patients as case and 40 healthy individuals as control group. Serum testosterone was estimated using ELISA technique and data analyzed statistically using SPSS program version 21. Results: this study revealed that testosterone level was decreased significantly in CKD patient compared with control group of (p-value 0.041). Furthermore, BMI also has significant effect on testosterone level with (p-value 0.013). Conclusion: this study has clarified that patient was developed hypogonadism as a result of CKD as well as increasing BMI.

Keywords: CKD, testosterone, BMI, hypogonadism.

INTRODUCTION

Chronic Kidney Disease, in addition to its heterogenous clinical disorders, it is the general term used to describe an irreversible loss of kidney function, persistent urine abnormalities, structural abnormalities or impaired excretory renal function suggestive of loss of functional nephron over a period of few years, (Romagnani *et al .,* 2017; Innes, 2009). CKD has global prevalence between 11% - 13% (Hill *et al.,* 2016). Several disease processes can lead to progressive, irreversible impairment of renal function. Glomerulonephritis, diabetes mellitus, polycystic pyelonephritis kidney, renovascular disease and polycystic kidney. All of these conditions lead to a decrease in the number of functioning nephrons. Patients may remain asymptomatic until the GFR falls below 15 mL/min (Marchall *et al.,* 2012).

The kidney is a potent endocrine organ, a key modulator of endocrine function and an important target for hormonal action, metabolism and excretion. Thus, several hormones are affected by CKD (Matthew, 2017; Songul *et al.,* 2012) the adequate secretion of male hormones and normal spermatogenesis are the responsibility of an integrated system that consists of the hypothalamus, the pituitary and the testes. Hence, pituitary secrete FSH and LH in response to

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hypothalamic (GnRH), where LH act on Leydig cell to stimulate steroidogenesis, while FSH act on Sertoli cell stimulating the spermatogenesis (layman, 2007).

Hormonal abnormalities and endocrine dysfunction are common in patients with CKD. Changes in testosterone level are caused by altered function of the hypothalamic pituitary axis and uremic syndrome that comprises a serious complication of chronic kidney disease. It occurs when urea and other waste products build up in the body because the kidneys are unable to eliminate those (Periklis, 2014). Serum concentration of testosterone is lower in HDP than healthy males (Kuczer *et al.,* 2016). That is associated with a significantly reduced quality of life, since the decreased testosterone levels in adult males are accompanied by a variety of unpleasant symptoms and severe conditions comprising Impaired sex drive, performance (low libido, erectile dysfunction, and ejaculation disorders), testicular atrophy, infertility, decrease in beard and body hair growth, decrease in muscle mass, visceral obesity, gynecomastia and depression (Andrew and Sanja, 2017).

These abnormalities can be the result of primary disease of the testes (primary hypogonadism) or of disease of the pituitary or hypothalamus (secondary hypogonadism), and the distinction can be made based on the levels of gonadotropins. Primary hypogonadism is characterized by low testosterone levels and sperm count associated with LH and FSH concentrations that are above normal, while in secondary hypogonadism, LH and FSH levels are normal or reduced (Renato *et al.,* 2013). Moreover, not only CKD affect testosterone level but obesity has a negative impact on it as well. obesity, as defined by (WHO) is excess weight gain for given height, it is important risk factor for developing hormonal abnormality, that can be explained by lower sex hormone-binding globulin (SHBG), insulin resistance and also high estrogen level (Arjonilla *et al.,* 2009), thus a variety of increasing in adipose tissue together with CKD result in the development of hypogonadism (Stephanie *et al.,* 2010).

METHODS

The participants in this study were a total of 80 subjects, defined (40 patients in stage-5 as case, and 40 as control group). Patients who have been clinically diagnosed with CKD ranging between (20-62) years and whose attended to be dialyzed in hemodialysis centers were included in this study. While, smokers, persons with pituitary tumor or even treated with high dose or long-term steroid hormone were excluded. Samples were collected before dialysis. This study was approved by medical ethics committee of Omdurman Islamic University before the study carried out. However, Permissions of this study has been obtained from health authorities in hemodialysis centers, and all participants were aware of the aim of the study. Serum testosterone in all participants under study was estimated by ELISA technique.

Statistical analysis

Data was analyzed using SPSS software program version 21 to determine the mean and SD and the relationship of sample parameter. The independent t-test was adopted for comparison of quantitative data between the groups and the Pearson correlation coefficient was calculated. P-value less than 0.05 considered as significant.

RESULTS

Upon the obtained results, testosterone concentration was significantly decreased among case rather than the control group with (P-value 0.041) as explained in figure (1). Further, BMI is correlated significantly in a negative manner with testosterone with values ($r = -0.443$, $p = 0.013$) as explained in figure (1).

On the other hand, table (1) explained that testosterone was significantly decreased in overweight patients with CKD compared to those who are normal weight with (P-value 0.044).

DISCUSSION

CKD is a worldwide health problem affecting the community with increasing prevalence between 11%-13% (Hill *et al.,* 2016). As CKD progresses, not only the accumulating physiological derangement disturbs the activities of other organs and tissues, but also many components of the endocrine system are affected. This is most evident in the extreme cases, dialysis-treated-end stage renal disease i.e. CKD stage-5, which affects testosterone level (Matthew, 2017) that appear in figure (1) and table(1) of presented study parameter which implement that testosterone was decreased significantly with (p- value 0.041) which can be owing to either uremia which impairs gonadal steroidogenesis and lead to testicular damage, or to an inhibitory factor in uremic serum which inhibit LH signaling at the level of the Leydig cells (Priya and Rebecca, 2007; Mahboob and Shirin, 2008). Furthermore, other factors such as tumor necrosis factor (TNF)-alpha play a role in lowering of testosterone; TNF increased in CKD as result of inflammatory state of disease (Manish and Raja, 2012). Beside that one, the increase in BMI has been shown to be associated with low testosterone levels (Hodeeb *et al.,* 2016) in the presented data in figure (2) found that BMI is inversely correlated to testosterone concentration which is decreased significantly with higher BMI of (p-value 0.013) and this is justified by an increase in the activity of the cytochrome p450 enzyme aromatase, resulting in

Table 1: Shows both the mean values of testosterone level in case and control group in addition to the effect of BMI among case group with CKD patients classified as normal weight and overweight

Parameter	Case (Mean ± SD)	Control (Mean ± SD)	*P-value*
Testosterone (ng/ml)	5.29 ± 1.53	5.95 ± 1.33	0.041
Variable BMI	**Normal weight(Mean ± SD)**	**Overweight (Mean ± SD)**	***P-value***
Testosterone (ng/ml)	5.45 ± 1.59	4.54 ± 0.99	0.044

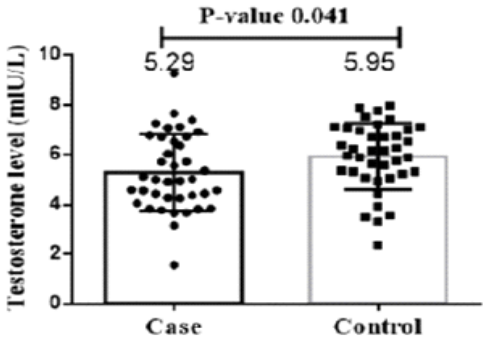

Figure 1: Testosterone Level in case VS Control

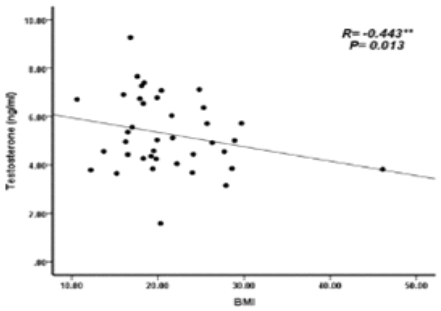

Figure 2: Testosterone & BMI

increased conversion of testosterone to estradiol, a phenomenon often termed the "testosterone-estradiol shunt). This not only reduces testosterone level but also gives rise to the preferential deposition of fat within abdominal depots, in the so called “hypogonadal-obesity cycle"(Saboor *et al.,* 2013, Stephanie *et al.,* 2010; Roth *et al.,* 2008; Andrew and Sanja, 2017), Leptin, although it primarily responsible for satiety, has been shown to influence male reproduction at the level of both testes and the HPG axis. Leptin levels are increased with fat mass and show an inverse relationship with serum testosterone levels in overweight and obese people. High leptin levels can negatively influence Leydig cell testosterone synthesis by either affecting LH action or inhibiting the conversion of 17-OH progesterone in to testosterone (Shukla *et al.,* 2014). It has been suggested that obesity associated metabolic syndrome such as insulin resistance affect (SHBG) level leading to low level of it, which consequently lowering total testosterone (Shalender *et al.,* 2006).

CONCLUSION

Hypogonadism is a well described hormonal derangement associated with CKD. After we pointed out the important point and factor that affect the testosterone, final result explains that there is significant decrease in its level in cases compared to control group. However, BMI shows same effect on testosterone.

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