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Effects of Human Chorionic Gonadotropin Therapy on Gonadal Function in Men Clinically Confirmed with Subfertility: An Interventional Study at a Teaching Hospital, Ghana

Samuel Aidoo[1,2], Akisibadek Alekz Afoko[3,4], Yussif Adams[1*], Peter Paul M. Dapare[1], Simon Bannison Bani[1], Vivian Afoko[5], Vera Alliah[5]

[1]Department of Biomedical Laboratory Science, School of Allied Health Sciences, University for Development Studies, Tamale, Ghana
[2]Laboratory Department, Tamale Teaching Hospital, Tamale, Ghana
[3]Department of Surgery, School of Medicine, University for Development Studies, Tamale, Ghana
[4]Department of Surgery, Tamale Teaching Hospital, Tamale, Ghana
[5]Department of Nursing, School of Nursing and Midwifery, University for Development Studies, Tamale, Ghana
Email: *adamsyussif@uds.edu.gh

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Abstract

The study aimed at assessing the effect of beta-human chorionic gonadotropin (βhCG) therapy on gonadal function in men with subfertility. This was an interventional study conducted at a teaching hospital in Ghana. A total of 57 clinically confirmed men with subfertility were recruited for the study. In addition to the demographic data, venous blood samples were collected, and baseline serum testosterone, luteinizing hormone (LH), and follicle stimulating hormone (FSH) were measured. Duplicate semen samples (mean values adopted) were collected and assayed following World Health Organization (2010) protocol. A dosage range of 1500 - 2000 IU βhCG was administered subcutaneously to each participant determined by the patients' weight and medical history. The frequency of injection was 4 shots every 7 (±1) days for a period of 30 days. Repeated measurements of serum testosterone, FSH, LH, and semen analysis were done 90 days after intervention. The data were analyzed using GraphPad Prism (v8.0) at an alpha value of 0.05. The participants were aged between 23 and 55 years. The mean ± SD serum total testosterone, FSH and LH at baseline were 12.6 ± 3.7; 7.8 ± 2.7; and 4.1 ± 1.5 respectively with testosterone (18.0 ± 4.0) and FSH (5.5 ± 2.7) improving significantly ($p < 0001$) after 90 days follow-up. At baseline, the mean ± SD of semen parameters; pH, semen volume, total sperm count, sperm concentration were 7.90 ± 0.267, 3.1 ± 0.91 mL, 36.1 ± 19.7 × 10^6/ejaculate and 11.5 ± 4.97 × 10^6/mL

respectively with total sperm count ($p < 0.0001$), sperm concentration ($p < 0.0001$), Active Forward Linear Progressive motility ($p = 0.0005$) and normal morphology ($p = 0.0005$) improving significantly after 90 days of follow-up. Beta-human chorionic gonadotropin (βhCG) therapy for subfertility is recommended since it improved gonadal function among men clinically diagnosed with subfertility, however, a multi-institutional study should be conducted to provide more evidence for this choice.

Keywords

Male Subfertility, Gonadal Function, Beta-Human Chorionic Gonadotropin, Semen Analysis, Ghana

1. Introduction

Subfertility is defined as a decrease in fertility characterized by an extended period of unsuccessful attempts to conceive, including several factors that may be reversed [1]. Subfertility is a relative condition since its characterization just signifies the potential for conception within a certain timeframe.

Empirical data indicates that around 84% of fertile couples will achieve conception within a span of one year, while a further 92% will do so within a two-year period [2]. Infertility and for that matter childlessness are often seen as a very distressing and unfortunate circumstance for individuals and couples, with far-reaching implications for their families and even the surrounding community. Childlessness is often associated with a range of adverse psychosocial outcomes, which may have significant and lasting effects. Some studies have reported that majority of couples with subfertility are from developing countries where detrimental effects of childlessness are experienced [3] [4]. The repercussions of childlessness may include marital instability, abuse and stigmatization particularly in Ghana [5] [6].

Male factor subfertility accounts for about 40% - 50% of childlessness [7] [8] and this is alarming especially in developing countries. There are treatment options available for male subfertility and these may include assisted reproductive technologies such as: aromatase inhibitors (AIs) and selective estrogen receptor modulators (SERMs) which have shown promise results however, methods are invasive, expensive, and may not guarantee success in every case [9]. The use of testosterone replacement therapy (TRT) has also gained popularity in the treatment of infertility [10]-[12], however, the potential side effects such as decrease in sperm count and motility, increase blood pressure, increase estradiol, increase red blood cells, gynecomastia have been reported [13] [14]. Alternatively, the European Association of Urology (EAU) and American Urology Association (AUA) recommendations have addressed the use of beta-human chorionic gonadotropin (βhCG) in men with subfertility to improve fertility [15] [16].

After implantation, the placenta releases human chorionic gonadotropin (hCG)

which is an analog of luteinizing hormone (LH). The LH-like activity of hCG stimulate the Leydig cells to produce testosterone and sperm production mechanisms within the testes, thus, useful in the treatment of male infertility [17] [18]. The side effects of βhCG treatment of infertility are found to be minimal as La Vignera, Condorelli [19] reported increase prostate specific antigen (PSA), prostate volume, hematocrit and estradiol. Thus, determining the effects of βhCG administration in the treatment of male subfertility is a compelling avenue of research. Understanding its potential benefits, safety, and cost-effectiveness can pave the way for more effective and accessible treatments for male subfertility, providing hope and support for successful conception and parenthood. Hence, the study aims to assess the effect of βhCG therapy on gonadal function in men clinically confirmed with subfertility.

2. Materials and Methods

2.1. Ethical Consideration

The study received approval from the Ethics and Review Board of the Department of Research and Development at Tamale Teaching Hospital (Number: TTH/R&D/SR/511). The study was therefore conducted in accordance with the guidelines outlined in the 1964 Declaration of Helsinki. Informed consent was obtained from all participants prior to the study. All participants were kept anonymous and any information obtained was treated with utmost confidentiality, accessible just to the researchers involved in the study.

2.2. Study Design

This was an interventional study design that was conducted at the Tamale Teaching Hospital in the Tamale Metropolis from September 2022 to January 2024. Therapeutic study design was applied in this study to explore the impact of supraphysiologic administration of βhCG in the treatment of male subfertility among the study population.

2.3. Participant's Recruitment

The study participants were patients who were clinically confirmed with subfertility after thorough evaluation and supervision by urology and fertility specialists at the Teaching hospital. Data collected included history of erectile function, ejaculation, frequency of coitus, scrotal disorders, lifestyle factors such as cigarette (tobacco) smoking, alcohol intake, and any medications taken. Participants included patients with: hypogonadotropic hypogonadism (low total testosterone, low FSH and LH concentrations), varicocele, and high atrophy index (>9).

A total of sixty (60) participants volunteered to participate in this study of which three (3) did not meet the inclusion criteria bringing the population to fifty-seven (57). Participants were informed of the recommended therapy (βhCG treatment) as part of the management plan [20] and were closely monitored for 70 - 90 days for subsequent evaluation and those who consented were selected for the study.

2.3.1. Inclusion Criteria

Participants with varicocele, male factor fertility, and abnormal seminogram alterations were included in the study. The eligible participants had complained of sexual dysfunction including weak sex drive, premature ejaculation, infrequency of sexual intercourse, and dissatisfaction after sexual intercourse activity. Male factor infertility occurs when a man is unable to impregnate a woman despite having unprotected sexual intercourse with an apparently healthy female for a duration of six (6) months. This condition is characterized by the absence of any abnormalities in the female reproductive history, ovulation, and tubal patency [21].

2.3.2. Exclusion Criteria

Patients who had a documented history of smoking, engaged in excessive alcohol consumption, used drugs or substances, or provided partial or inconclusive responses on the questionnaires were excluded from the study. Patients with a medical history of mumps orchitis, uncontrolled hypertension (with blood pressure levels over 140/90 mmHg), uncontrolled diabetes (indicated by glycated hemoglobin levels >7%), use of anti-androgen and/or testosterone replacement treatment, undescended testis, or previous orchidectomy were also excluded. Participants who use drugs or medications known to impair testicular function, past or present oncological treatment were also prohibited in this study.

2.4. Baseline Data Collection

Socio-demographic data and medical history were collected using semi-structured pretested questionnaire. Anthropometric measurements were done on all participants. The participants' height (cm) and weight (kg) were measured using a stadiometer and weight scale respectively. Body Mass Index (BMI) was calculated by dividing weight by height in square meters. Two blood pressure readings were taken at 5 minutes relaxation interval and average blood pressure calculated [22].

2.4.1. Sample Collection, Preparation and Storage

The participants were instructed to fast for a minimum of 8 hours prior to the blood collection. The conventional venipuncture procedures were used for the blood sampling procedure. Venous blood samples of 4 mL, were collected from each participant and transferred into a 5 mL tube containing a serum separator gel within the time range of 8:00 - 11:00 GMT. The concentration of testosterone naturally fluctuates throughout the day, reaching a peak around 8:00am and a trough around 8:00pm, when it drops to about 70% of the morning peak.

The blood samples were allowed to clot in the vacutainer and processed by centrifugation at a speed of 3500 revolutions per minute for a duration of 5 minutes to acquire serum. The serum was aliquoted in 2 cryovials and kept at a temperature of −20˚C until assay.

2.4.2. Hormonal Measurements

Baseline male fertility hormones (total testosterone, FSH, and LH) were measured using an electrochemiluminescence Hitachi-Roche analyzer (Cobas 6000, Roche

Diagnostics, IN, USA).

2.4.3. Semen Collection and Analysis

Participants were given instructions to abstain from any form of sexual intercourse for a minimum of 3 to 5 days as per the guidelines of laboratory test. A clean sterile wide-mouthed plastic container confirmed to be non-toxic for spermatozoa was given to each participant to produce semen samples by masturbation (two semen samples-mean value adopted). To minimize temperature fluctuations and control the time between semen sample collection and analysis, samples were collected in a private room near the laboratory.

Macroscopic analysis of the semen was performed with the observation of liquefaction time, viscosity, semen volume, color, and pH. For microscopic analysis, a 100 µm-deep disposable Neubauer hemocytometer chamber was loaded with a well-mixed liquefied semen sample, covered with a coverslip allowing spermatozoa to settle in the chamber. Sperm concentration count and sperm motility were determined using ×200 magnification. Only spermatozoa with head and tail were counted and reported. The semen was analyzed according to WHO criteria [21]. Vitality was measured using Eosin Y 0.5% dye (Eosin Gelblich, Darmstadt, Germany). Sperm morphology was determined according to Kruger criteria using Nigrosin 8% staining technique (Nigrosin, Water Soluble, Darmstadt, Germany) [23].

2.5. Intervention

Participants were counselled about their condition and the available treatment options by a fertility specialist. A dosage range of 1500 - 2000 IU βhCG was administered subcutaneously to each participant determined by the patients' weight and medical history. The frequency of injections was 4 shots every 7 (±1) days for a period of 30 days.

2.6. Follow-Up

The patients were followed up and monitored for 90 days after the last dose of βhCG. Participants were advised against the use of contraceptives during sexual intercourse, and to abstain from statin medications and cigarette smoking as it appears to affect the concentration and morphology of sperms. Participants were reassessed and clinically examined after 90 days of their last therapy. Venous blood and semen samples were drawn for repeated measurements.

2.7. Statistical Analysis

The data were entered into Microsoft Excel version 2021 and then exported to GraphPad Prism version 8.0 (http://www.graphpad.com/) for analysis. Categorical data were presented using frequency, percentage, charts, and inferred using Chi-square test. The Kolmogorov-Smirnov test was conducted on the quantitative data to assess the normality of the distribution. Parametric data were presented as

mean ± standard deviation (SD) while the non-parametric data were presented with median (interquartile range). A paired student t-test was used to compare the variables before and after the procedure. A p-value less than 0.05, in a two-tailed test, was considered statistically significant.

3. Results

3.1. The Socio-Demographic Characteristics of the Study Population

The general characteristics of the study population are described in Table 1 below. The participants were aged between 23 and 55 years old. A greater proportion (94.7%) of the participants were married and sexually active, 89.4% had formal education, and 52.6% self-employed. About 63.1% were the amongst the Mole-Dagomba tribe. Scrotal examination revealed that 15.7% had varicocele grade II with none of the participants with grade I varicocele.

Table 1. General (categorical variables) characteristics of study participants.

Variable	Frequency (n = 57)	Percentage (%)
Married	54	94.7
Formal Education	51	89.4
Ethnicity		
Mole-Dagomba	36	63.1
Other Tribes	21	36.8
Occupation Status		
Gainfully employed	18	31.5
Self-employed	30	52.6
Unemployed	9	15.7
Varicocele Grade		
II	9	15.7
III	1	1.8

Data presented as frequency and percentage.

3.2. Anthropometric Characteristics of Study Participants

As shown in Table 2, the mean and standard deviation for diastolic blood pressure (DBP) (80.2 ± 7.9 vs 97.4 ± 8.5) and pulse (72.0 ± 10.9 vs 78.4 ± 9.6) observed significant increased post treatment, $p < 0.0001$ and $p = 0.0017$ respectively. However, the weight, height and body mass index (BMI) did not vary ($p > 0.05$) comparing the baseline and the follow-up measurements.

Table 2. Pre- and post-treatment anthropometric measurements over 90 days of follow-up.

Anthropometric Measurements	Baseline			Follow-up			P value
	Min	Mean ± SD	Max	Min	Mean ± SD	Max	
Weight (kg)	50.5	71.2 ± 11.5	95	51	71.2 ± 11.3	96	0.5037
Height (cm)	75	169.1 ± 13.4	191	75	169.1 ± 14.1	191	0.1591
BMI (kg/m^2)	17.9	24.7 ± 3.6	35	17.6	26.2 ± 4.9	31.8	0.1223
Blood Pressure							
SBP (mmHg)	101	124.6 ± 10.1	140	104	124.8 ± 7.9	137	0.7896
DBP (mmHg)	61	80.2 ± 7.9	98	72	97.4 ± 8.5	104	<0.0001
Pulse (beat/min)	51	72.0 ± 10.9	84	59	78.4 ± 9.6	98	0.0017

Data presented as mean and standard deviation (SD); p-value <0.05 considered statistically significant.

3.3. The Distribution of Gonadal Function Over 90 Days of Follow-Up among Study Participants

At baseline, the median (interquartile range) of serum testosterone [12.0 (7.9 - 16.1)] nmol/L significantly ($p < 0.0001$) increased to 18.2 (13.8 - 22.6) nmol/L after 90 days follow-up post treatment. The follicle stimulating hormone (FSH) was 6.9 (3.9 - 9.9) IU/L at baseline but significantly ($p < 0.0001$) decreased to 4.9 (1.8 - 8.0) IU/L, while no significant changes ($p = 0.0772$) was observed for luteinizing hormone (LH) before [3.8 (1.7 - 5.9)] IU/L and after [2.9 (1.1 - 4.7)] IU/L 90 days follow-up (Figure 1).

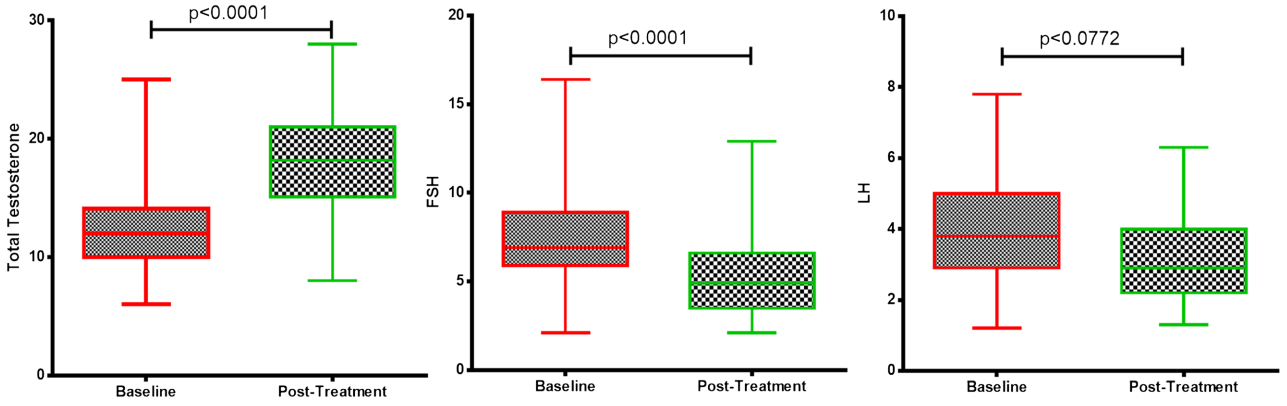

Figure 1. Gonadotropins levels before and after treatment with βhCG.

3.4. Pre- and Post-Treatment of βhCG on Seminal Parameters Over 90 Days of Follow-Up

As shown in Table 3, total sperm count ($p < 0.0001$), sperm concentration ($p < 0.0001$), active forward linear progressive (AFLP) motility ($p = 0.0005$), nonprogressive sperm motility ($p = 0.0446$), total motile count ($p < 0.0001$), viable sperms

(p = 0.0091) and morphological normal forms (p = 0.0014) values increased in patients who had undergone βhCG treatment. However, immotile sperms (p = 0.0092) and abnormal morphology (p = 0.0013) decreased significantly after therapy respectively.

Table 3. Comparison of semen analysis before and after βhCG therapy.

Variable	Baseline (Pre-treatment)	Post-Treatment	p-value
Semen Analysis			
pH	7.9 ± 0.27	7.98 ± 0.15	0.2702
Volume/mL	3.1 ± 0.92	3.16 ± 0.91	0.8800
Total Sperm Count (×10⁶/ejaculate)	36.1 ± 19.69	63.5 ±4 0.69	<0.0001
Sperm Concentration (×10⁶/mL)	11.5 ± 4.98	19.4 ± 9.91	<0.0001
Motility (AFLP) (%)	29.4 ± 11.43	38.4 ± 11.58	0.0005
Motility (Nonprogressive) (%)	18.1 ± 6.60	15.6 ± 7.04	0.0446
Motility (Immotile) (%)	52.6 ± 11.59	46.0 ± 11.93	0.0092
Total Motile Count (mL)	17.3 ± 9.91	33.9 ± 23.48	<0.0001
Viability (% of total)	47.4 ± 11.59	54.0 ± 11.93	0.0091
Morphology (Normal) (%)	59.2 ± 14.09	66.2 ± 12.09	0.0014
Morphology (Abnormal) (%)	40.8 ± 14.09	33.8 ± 12.09	0.0013

Data presented as mean and standard deviation (SD); Pared student t-test to compare variable before and after measurement; p-value <0.05 considered statistically significant.

3.5. Pre- and Post-Treatment Categories of Semen Parameters among the Participants

The proportion of participants with total sperm count, sperm concentration, active forward linear progress (AFLP) and total percent variability were significantly normalized 90 days post treatment with βhCG (78.6%, p < 0.0001; 64.3% p < 0.0001; 70.0%, p < 0.0001; 39.3% p = 0.0050) compared with baseline (35.7%, 21.4%, 37.5% and 19.6% respectively). Furthermore, immotile sperm concentration significantly (p < 0.0001) decreased from 87.5% baseline to 39.3% post treatment (Table 4).

3.6. Percentage Change in Hormonal Parameters.

The hormonal analysis saw a percentage increase in testosterone (42.86%) among the participants. Follicle stimulating hormone (FSH) (−41.82%) and luteinizing hormone (LH) (−17.14%) were however reduced after 90 days follow-up post treatment (Figure 2).

Table 4. Proportion of selected semen parameters before and after βhCG therapy.

Variable	Baseline, n (%)	Post-treatment, n (%)	P-value
Total Sperm Count (×10⁶/ejaculate)			
Normal	21 (37.5)	44 (78.6)	<0.0001
Low	35 (62.5)	12 (21.4)	
Sperm Concentration (Million/mL)			
Normal	12 (21.4)	36 (64.3)	<0.0001
Low	44 (78.6)	20 (35.7)	
Motility (AFLP) (%)			
Normal	21 (37.5)	39 (70)	<0.0001
Low	35 (62.5)	17 (30)	
Motility (Nonprogressive) (%)			
Normal	1 (1.78)	2 (4)	0.6827
Low	55 (98.2)	54 (96)	
Motility (Immotile) (%)			
Normal	7 (12.5)	44 (78.64)	<0.0001
High	49 (87.5)	22 (39.3)	
Viability (% of total)			
Normal	11 (19.6)	22 (39.3)	0.0050
Low	45 (80.4)	34 (60.7)	

Data presented as frequency and percentage; Categorical variables compared using Chi-square test and/or Fischer's exact test; p-value <0.05 considered statistically significant.

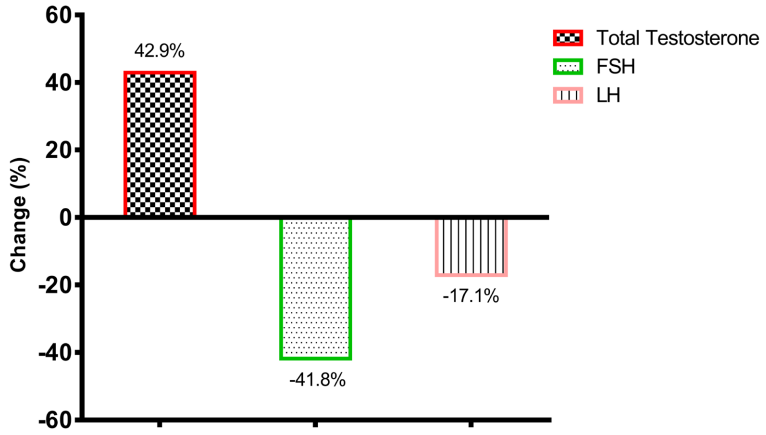

Figure 2. Percentage change in hormonal parameters.

4. Discussion

This study aims to determine the effects of human chorionic gonadotropin (βhCG) treatment outcomes on male subfertility in a Ghanaian population. Infertility affects over 70 million couples worldwide [24] with male subfertility accounting for 40% - 50% of these cases [7]. According to Bobjer, Bogefors [8], male factor fertility account for about half of infertility cases with most common causes being spermatogenesis agents, hereditary factors, vascular illnesses, and semen abnormalities [25]. In this study, all participants were clinically confirmed and diagnosed with subfertility based on the World Health Organization's criteria [26].

An adequate pituitary secretion of LH and FSH for testosterone biosynthesis and spermatogenesis are prerequisites for sperm production. Male hypogonadism has been extensively treated with testosterone replacement therapy [16], which usually includes aromatase inhibitors, βhCG, selective Estrogen receptor modulators and exogenous testosterone [27]. However, exogenous testosterone administration has been shown to inhibit the HPG axis leading to infertility in men [28]. In this study, βhCG administration was the treatment of choice for male subfertility. The literature on the uses of βhCG in men has focused on its use in hypogonadal men to preserve fertility. The βhCG has been indicated as part of an algorithm to assist in the recovery of endogenous testosterone biosynthesis by stimulating Sertoli cell maturation [29].

There have been several studies that showed a significant improvement in gonadal function following βhCG therapy [30]-[33]. Shoshany, Abhyankar [34] reported an improvement in the serum testosterone level from a mean 21.1 nmol/L to 36.9 nmol/L in men with physiologically normal levels of testosterone after administering βhCG. Joseph, Gibbs [35] also evaluated the use of hCG in hypogonadal men who wished to preserve fertility and found that βhCG improved serum testosterone levels by 281.1 ng/dl (9.78 nmol/L), from 284.46 ng/dL (9.87 nmol/L) to 565.55 ng/dL (19.62 nmol/L) after 90 days therapy. This is consistent with the current study which found a significant increase in serum testosterone levels after 90 days of treatment with βhCG. This may be attributed to the restoration of the Leydig cell function from the endogenous activity of βhCG.

Other studies have also made reports on a similar trend on the effect of βhCG administration on serum testosterone. Tsujimura, Matsumiya [30] evaluated the efficacy and safety of βhCG for hypogonadal patients in 21 men with hypogonadism between 3 to 24 months. Serum concentrations of testosterone and testosterone/estradiol (T/E) ratio increased significantly from 7.29 nmol/L to 9.37 nmol/L, and from 7.3 nmol/L to 9.5 nmol/L respectively. They reported an improvement in the Androgen Deficiency in the Aging Male (ADAM) score and the International Index of Erectile Function (IIEF) score in the patients treated with βhCG. Ishikawa, Ooba [31] follow-up on 26 hypogonadal patients found that those who were administered with βhCG had significantly raised levels of testosterone and testosterone/estradiol ratio. Additional comparable reports can be made with [19] evaluation of 40 hypogonadal patients treated for 6 months with βhCG.

Rainer, Pai [36] aimed to evaluate for symptom improvement and side effects of hCG monotherapy in hypogonadal men with testosterone >300 ng/dL (10.41 nmol/L). The pre-analysis supported the view that hCG is homologous to LH, and is known to stimulate endogenous testosterone, as an option for testosterone replacement therapy. A study conducted by Depenbusch, von Eckardstein [37] reported suppression of FSH and LH after administration of hCG in hypogonadal men. This current finding of a decrease in FSH and LH post treatment with βhCG is in agreement with earlier findings by Rainer, Pai [36] and Depenbusch, von Eckardstein [37].

The production of sperms depends on a functionally intact hypothalamic-pituitary-gonadal (HPG) axis with normal pituitary secretion of LH and FSH for testosterone biosynthesis and spermatogenesis. Significant improvement in semen quality; semen volume, sperm concentration, total sperm count, total motile count, active forward linear progressive (AFLP) motility, sluggish motility, normal morphological forms and viable sperms was seen among the study participants after treatment with human chorionic gonadotropin (βhCG) from the baseline after 90 days. This conforms with other studies [35] [37]-[39] who found the ability of βhCG to preserve spermatogenesis and improve semen parameters in hypogonadal men. This may be as a result of the LH-like activity of βhCG to stimulate testosterone production by the Leydig cells, for the enhancement and maintenance of spermatogenesis [40].

The ultimate evidence of fertility status among subfertile couples is pregnancy outcome. The administration of βhCG therapy can improve the fertility rate and better spermatogenesis with lower adverse effects in patients with deranged semen parameters. Previous studies reported the sperm morphology alone was good enough to predict pregnancy success [41], while other authors demonstrated a definite decline in pregnancy rate when the normal sperm morphology declines below 8% [42]. Slama, Eustache [43] also measured the association between time to pregnancy and semen parameters and concluded that the proportion of normal sperm morphology raised the time to pregnancy to a threshold value of 19%. In contrast to this, Van der Merwe, Kruger [44] demonstrated that although each semen parameter showed a good predictive value for increased fertility rate, the clinical value of semen analysis increased when the parameters are used in combination. A study by Nallella, Sharma [45] also stated that sperm motility and concentration are better predictors of fertility potential than assessment of sperm morphology as stated in the WHO guidelines [46] and Tygerberg's strict criteria [47]. In this study a significant increase in overall percentage change in total sperm count, sperm concentration, AFLP motility, normal sperm morphology [21], and the total motile count was a tool for substantial discriminative ability in male factor fertility.

Despite several findings reporting about the significant effect of βhCG on semen parameters, other studies found inconsistent conclusions on the otherwise known literature. A placebo-controlled study on the effectiveness of βhCG in in-

fertile men with oligospermia was conducted by Kumar, Gautam [48] and reported a strong evidence that βhCG treatment schedule did not improve semen parameters. It was concluded that increasing serum gonadotropin through the effect of βhCG above the normal physiological range does not improve the production of sperms. This may be as a result of altered LH pulse rate or decreased LH bioactivity. The theory of antibodies developed against βhCG preparation could be induced during treatment. In this study however, there was improvement in testicular function in the form seminal parameters due to the positive effect of βhCG on Leydig and Sertoli cells. This finding is in line with [20] [49] [50] who reported modest response rates in the concentration and total sperm count in semen parameters in hypogonadal, severe oligospermic men. An improvement in semen parameters was observed among participants in this study after treatment. This may imply that the mechanism hypothalamic-pituitary-gonadal axis was functionally restored.

The study found significant increment in diastolic blood pressure ($p < 0.0001$) and pulse ($p = 0.0017$) post treatment. This could be the clinical implications of βhCG treatment although most of the studies have concluded no adverse side effects of hCG therapy for hypogonadism [51] [52]. However, few studies have reported increase hematocrit, estradiol PSA, prostate volume, and mood swing [12] [19]. Future studies should consider monitoring potential long-term side effects of βhCG therapy on male subfertility.

5. Conclusion

The results from this study showed a significant improvement in gonadal function and semen parameters after βhCG treatment. Beta-human chorionic gonadotropin therapy for subfertility in men is recommended since it has demonstrated efficacy in improving gonadal function. However, findings from this study should be verified by a multi-institutional study to provide more evidence for this choice.

Acknowledgements

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Approval of the Research Protocol

The study received approval from the Ethics and Review Board of the Department of Research and Development at Tamale Teaching Hospital (Number: TTH/R&D/SR/511).

Informed Consent

All patients provided written informed consent before the start of the study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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