REVIEW

Linking testosterone to men's health

O. Danny Lee*

School of Nursing, Southeastern Louisiana University, Hammond, Louisiana, United States

Received: September 24, 2023 **Accepted:** November 5, 2023 **Online Published:** November 9, 2023
DOI: 10.5430/cns.v12n1p1 **URL:** https://doi.org/10.5430/cns.v12n1p1

ABSTRACT

Understanding the role of testosterone and its impact on the overall health of men is important for healthcare providers who serve this patient population. To understand the impact of testosterone on men's health, the healthcare provider must understand the function of testosterone, the implications of low testosterone on men's health, symptoms of low testosterone, tests to determine testosterone level, and testosterone therapy. Also, it is important to understand the potential side effects and contraindications of testosterone therapy. This paper attempts to provide healthcare providers with essential aspects of the function of testosterone on men's health and basic knowledge of testosterone therapy.

Key Words: Testosterone, Men's health, Testosterone therapy

1. INTRODUCTION

Testosterone plays an important role in men's overall health. All healthcare providers should have a basic knowledge and understanding of the function of testosterone and its impact on the growth and development of men. Serious adverse health conditions occur as a result of inadequate testosterone levels. Therefore, healthcare providers who work with men and adolescent boys should know what signs and symptoms may result as well as the potential negative impact on overall health that often occurs as a result of not enough testosterone being produced. Healthcare providers who serve this population should understand the tests performed to identify testosterone blood levels. A knowledge of the various forms of testosterone therapy and the advantages and disadvantages of each is necessary for healthcare providers serving this population. Finally, the possible side effects and potential negative impacts of testosterone on men's health is essential for the healthcare provider to understand.

2. FUNCTION OF TESTOSTERONE

Testosterone is the male sex hormone that is made in the testicles and is important for normal male sexual development and functions.[1] Testosterone is essential for developing male features. Areas affected include muscles (strength), vocal folds (deepening voice), and hair (body and facial). Adequate testosterone levels are necessary for sperm production. Testosterone also helps maintain bone density and aids with fat distribution and red blood cell production. Testosterone levels generally peak during adolescence and early adulthood. As men age, their testosterone level gradually declines typically about one percent a year after age forty.[2] Testosterone deficiency can lead to cardiovascular disease, muscle wasting, and bone density. Adequate testosterone levels are necessary to maintain normal blood pressure and

*Correspondence: O. Danny Lee; Email: oscar.lee@selu.edu; Address: School of Nursing, Southeastern Louisiana University, Hammond, Louisiana, United States.

insulin levels.[3]

3. Decreased or absence of testosterone

Blood levels of testosterone will fall if the testicles produce lower than average amounts of testosterone. Low testosterone is referred to as hypogonadism. Hypogonadism hampers the ability to produce normal amounts of testosterone due to a problem with the testicles or with the pituitary gland that controls the testicle.[4] For older men, it's important to determine if a low testosterone level is due to normal aging, a disease process, or trauma. Some studies suggest that as many as twenty-five percent of men over age forty-five have low testosterone.[5] The presence of other health-related conditions such as diabetes increases the risk for low testosterone levels. One study suggested that twenty-four percent of men with diabetes and thirty percent of men who are overweight have low testosterone.[2] Congenital conditions such as Klinefelter syndrome, Noonan syndrome, or abnormally formed sex organs interfere with testosterone production. Tumors or trauma to the male sex organs also can lead to lower testosterone.[3]

In addition to the adverse impact on male development and reproduction, testosterone deficiency can be associated with a number of disease processes such as cardiovascular disease, cancer, diabetes, osteoporosis, depression, Alzheimer's, and metabolic syndrome X.[6] Testosterone plays a role in regulating lipid metabolism, including the balance between good (HDL) and bad (LDL) cholesterol levels. Low testosterone levels might lead to unfavorable lipid profiles, with increased LDL cholesterol and decreased HDL cholesterol, which are known risk factors for cardiovascular disease.[7] Testosterone helps in maintaining lean muscle mass and reducing fat accumulation. Low testosterone levels have been linked to an increase in body fat and a decrease in muscle mass, both of which are associated with an elevated risk of cardiovascular disease. Low testosterone levels have been linked to insulin resistance, which is a key factor in the development of type 2 diabetes.[8] Diabetes is a significant risk factor for cardiovascular disease due to its negative effects on blood vessels and the heart. Testosterone has anti-inflammatory effects and is believed to support healthy endothelial function (the inner lining of blood vessels).[8] Low testosterone levels might lead to increased inflammation and impaired endothelial function. Testosterone can influence blood pressure regulation by affecting the activity of the renin-angiotensin-aldosterone system. Low testosterone levels might contribute to higher blood pressure, which is a major risk factor for cardiovascular disease.[8] Testosterone may also influence platelet function and clotting mechanisms. Low testosterone levels can potentially lead to an increased risk of blood clot formation. which is associated with various cardiovascular events.[8] Low testosterone levels can also have an impact on mood, energy levels, and overall well-being. Chronic stress and mood disorders can contribute to the development of cardiovascular disease.[9]

4. Manifestations of low testosterone

Diagnosing low testosterone is often delayed because the symptoms associated with testosterone deficiency are similar to the symptoms presented by many other disease processes and health conditions.[4] Symptoms of low testosterone include low sex drive, fatigue, reduced lean muscle mass, loss of body or facial hair, irritability, erectile dysfunction, and depression. These symptoms may also occur with opioid use, some congenital conditions, loss of or harm to the testicles, diabetes, and obesity. This can often make diagnosing testosterone deficiency difficult. Testing for the total blood testosterone level remains an important measure of testosterone deficiency. However, it is usually a combination of low testosterone levels along with the presence of signs and symptoms that lead practitioners to initiate testosterone therapy.[10]

5. Diagnosing low testosterone

To make a diagnosis of testosterone deficiency, the practitioner will use the presence of specific signs and symptoms along with low testosterone blood levels. The American Urology Association identifies low blood testosterone as less than 300 nanograms per deciliter (ng/dL).[11] Again, it is usually the combination of signs and symptoms along with low blood levels that lead to testosterone therapy being initiated. In recent years, there has been a lot more attention towards testosterone therapy, and more men between the ages of 40 and 64 have been tested and started on testosterone therapy.[9] Testosterone therapy should not be initiated with the presentation of symptoms alone due to the danger of excessive testosterone levels. Testosterone levels should always be tested before testosterone therapy is begun.[7] However, some practitioners will not initiate testosterone therapy if testosterone is only marginally below normal levels (less than 300 ng/dL) if no symptoms are present.[9]

6. Forms of testosterone replacement

The are many forms of testosterone therapy including gel, injection, patch, buccal, nasal spray, and implantable pellets. There are advantages and disadvantages of each method of testosterone replacement. Gel, patches, buccal, and nasal

ISSN 2324-7940 E-ISSN 2324-7959

spray usually must be administered daily to achieve adequate blood levels and achieve the desired therapeutic benefit. Intramuscular injections are usually twice a month but usually do not offer consistent sustained blood levels.[7] Intramuscular injections are the preferred method for most insurance due to the lower cost associated with this form of therapy.[7] Transdermal doses are typically intended to be replacement doses, with the patch being administered at a dose of 5–10 mg T/day and gel administration involving a somewhat greater amount of testosterone due to lower absorption. Injection of testosterone typically delivers higher amounts, 50–400 mg every 2–4 weeks.[7]

Pellets are inserted transdermal in the sacrum area every three to four months. Pellets usually provide the best therapeutic outcomes by achieving a more sustained blood level of testosterone. However, this is the most expensive form of testosterone therapy and most insurance does not cover pellet implants. Blood levels should be monitored along with the absence of signs and symptoms of hypogonadism to ensure desired levels of testosterone. Testosterone levels are usually drawn every six months.[7]

7. Side effects and contraindications of testosterone therapy

There are side effects associated with testosterone therapy. Some of these side effects are mild while others are more serious. Men should be educated on these side effects, and how to monitor for and identify these side effects. Topical treatments may lead to skin redness (gels and liquids) and rash or itching (patches) at application site.[4] Injections may cause reactions. With long-acting forms of testosterone, patients may have serious allergic reactions; for this reason, they should be monitored in the practitioner's office for a period of time following the injection, usually at least ten minutes.[4] For testosterone pellets, injected subcutaneously, side effects include swelling, pain, bruising, and rare hematoma.[4]

With testosterone therapy, there is an increased risk of erythrocytosis so it is essential that hemoglobin and hematocrit levels are closely monitored.[11] For most men, blood levels are monitored every six months.[11] Testosterone therapy should be avoided for patients trying to have children because testosterone therapy may interrupt normal sperm production. Topical testosterone may transfer to others and cause harmful effects. Patients should cover the application area carefully and wash their hands after applying the medication.[6] While there is no strong evidence linking testosterone therapy with prostate cancer, blood clots, or cardiovascular disease, these complications can occur. There are no large long-term randomized clinical trials to provide definitive conclusions about testosterone replacement therapy and cardiovascular risk. However, there is a significant amount of literature from the past several decades that provides a link between low serum testosterone concentrations and increased cardiovascular risk and mortality, and that suggests that testosterone replacement therapy may have clinically relevant cardiovascular benefits.[6]

Therefore, patients receiving testosterone therapy should have an annual prostate exam. Patients should also be instructed on the signs and symptoms of clot formation, stroke, and cardiac symptoms and be advised to report those symptoms to their practitioner as soon as they occur.[6]

8. Discussion

Testosterone is essential for the development, reproductive health, and overall health of men. Testosterone deficiency is a well-established major medical condition that negatively impacts male sexuality, general health, and quality of life. Symptoms include decreased libido, erectile dysfunction, decreased energy, depressed mood, irritability, and decreased sense of well-being. In the correct clinical setting, the diagnosis of testosterone deficiency is usually confirmed by low serum concentrations of total T (e.g., < 200 ng/mL) drawn in the early morning.[10] For men who have low levels of testosterone and display symptoms, testosterone therapy may be necessary for normal male body functions and quality of life. This therapy requires careful monitoring for the desired blood levels of testosterone and state of health.[10] It is also necessary to monitor for and minimize side effects and contraindicated outcomes of testosterone therapy such as such as erythrocytosis. Testosterone therapy can lead to an increase in the production of red blood cells (erythrocytosis); due to this, it is important to get a regular blood count.[10] Therefore, it is necessary to monitor red blood cell count with testosterone replacement therapy. An increase in red blood cell production can increase the thickness of the blood, which may result in other complications. The signs and symptoms of this condition are similar to anemia, which include dizziness, weakness, fatigue, headache, and joint pain.[10] It's natural for testosterone levels to vary depending on the patient's age and overall health.[4] For some men, testosterone levels remain high throughout life. However, for most men, testosterone levels begin to decline at about age 40. The decline in men is gradual, averaging just over 1% a year. This drop is imperceptible at first, but by age 70, the average man's testosterone production is 30% below its peak.[4]

If they're consistently high or low, patients may experience symptoms and need medical intervention. Low testosterone levels in men can lead to symptoms that can affect many dif-

ferent aspects of health and well-being. Many men who experience a decrease in testosterone report sleep disturbances and insomnia, emotional changes such as depression, and issues related to their sexual performance/desires. There is also considerable evidence from studies over the past several decades that prolonged lower testosterone levels can be associated with cardiovascular disease.[10] Higher testosterone levels can lead to an increase in the production of red blood cells (erythrocytosis). An increase in red blood cell production can increase the thickness of the blood, which may result in other complications such as clotting disorders.[4]

9. Conclusion

Testosterone indeed plays a critical role in men's growth, development, and overall health. Serious adverse health conditions often occur as a result of low testosterone blood levels. Healthcare providers who work with men and adolescent boys need to understand the signs and symptoms that may result as well as the potential negative impact on overall health that often occurs as a result of low testosterone levels. Healthcare providers who serve this population need to understand the tests performed to identify testosterone blood levels. A knowledge of the various forms of testosterone therapy and the advantages and disadvantages of each is necessary for healthcare providers serving this population. Finally, knowing the possible side effects and potential negative impacts of testosterone therapy on men's health is important for healthcare providers to understand in order to provide adequate care for this patient population.

Acknowledgements

Not applicable.

Funding

Not applicable.

Conflicts of Interest Disclosure

The author declares there is no conflicts of interest.

Informed consent

Not applicable.

Ethics approval

The Publication Ethics Committee of the Sciedu Press. The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

References

[1] Barbonetti A, D'Andrea S, Francavilla S. Testosterone replacement therapy. Andrology. 2020; 8(6): 1551-66.PMid: 32068334. https://doi.org/10.1111/andr.12774

[2] Salonia A, Pontillo M, Capogrosso P, et al. Severely low testosterone in males with COVID-19: a case-control study. Andrology. 2021; 9(4): 1043-52. PMid: 33635589. https://doi.org/10.1111/andr.12993

[3] Nieschlag E, Behre HM, Bouchard P, et al. Testosterone replacement therapy: current trends and future directions. Hum Reprod Update. 2004; 10(5): 409-19. PMid: 15297434. https://doi.org/10.1093/humupd/dmh035

[4] Huo S, Scialli, AR, McGarvey S, Hill E, Tügertimur B, Hogenmiller A, Hirsch AI, Fugh-Berman A. Treatment of men for "low testosterone": a systematic review. PLoS ONE. 2016; 11(9): e0162480. PMid: 27655114. https://doi.org/10.1371/journal.pone.0162480

[5] Cunningham GR, Stephens-Shields AJ, Rosen RC, et al. Testosterone treatment and sexual function in older men with low testosterone levels. J Clin Endocrinol Metab. 2016; 101(8): 3096-104. PMid: 27355400. https://doi.org/10.1210/jc.2016-1645

[6] Schub T, Smith N, Pravikoff D. Testosterone replacement therapy in men. In: Nursing reference center plus [Internet]. EBSCO Publishing; 2018 Apr.

[7] Tsampoukas G, Pang KH, Papatsoris A, et al. Testosterone replacement therapy in the aged male: monitoring patients' quality of life utilizing scoring systems. Int J Gen Med. 2022; 15: 7123-30. PMid: 36105846. https://doi.org/10.2147/IJGM.S253183

[8] Dohle GR, Arver S, Bettocchi C, et al. Male hypogonadism. In EAU guidelines on sexual and reproductive health. Anthem, The Netherlands: EAU Guidelines Office; 2023. 13-35 p. Available

from: https://uroweb.org/guidelines/sexual-and-reproductive-health/chapter/male-hypogonadism

[9] Snyder PJ, Bhasin S, Cunningham GR, et al. Testosterone Trials Investigators. Effects of testosterone treatment in older men. N Engl J Med. 2016; 374(7): 611-24. https://doi.org/10.1056/NEJMoa1506119 PMid:26886521 PMCid:PMC5209754

[10] Metzger SO, Burnett AL. Impact of recent FDA ruling on testosterone replacement therapy (TRT). Transl Androl Urol. 2016; 5(6): 921-6. PMid: 28078224. https://doi.org/10.21037/tau.2016.09.08

[11] Vigen R, O'Donnell CI, Barón AE, et al. Association of testosterone therapy with mortality, myocardial infarction, and stroke in men with low testosterone levels. JAMA. 2013; 310(17): 1829-36. PMid: 24193080. https://doi.org/10.1001/jama.2013.280386