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Original Article

The Long-Term Urological Consequences of Anabolic Steroid Abuse: A Narrative Review

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ABSTRACT
Background: Anabolic-Androgenic Steroids (AAS) have been widely used to enhance muscle mass and physical performance. However, their prolonged use has been associated with various adverse effects on urological health, including hypogonadism, infertility, erectile dysfunction (ED), and benign prostatic hyperplasia (BPH). Suppression of the hypothalamic-pituitary-gonadal (HPG) axis due to AAS leads to significant hormonal imbalances and long-term reproductive consequences.
Objective: This study aims to review the urological effects of AAS, focusing on their impact on testosterone levels, spermatogenesis, erectile function, and prostate health. The review highlights potential risks and clinical implications for individuals using AAS.
Method: A narrative review was conducted by analyzing relevant studies from PubMed, Scopus, and Science Direct published between 2014-2024. Articles were selected based on their relevance to the impact of AAS on urological health, particularly hypogonadism, infertility, ED, and BPH. Data from clinical trials, cohort studies, and systematic reviews were synthesized to provide a comprehensive analysis.
Results: Chronic AAS use significantly reduces endogenous testosterone production, leading to hypogonadism and associated symptoms such as fatigue, decreased libido, and mood disturbances. Studies indicate a strong correlation between AAS use and impaired spermatogenesis, with some cases resulting in irreversible infertility. Moreover, AAS users have a higher prevalence of ED compared to non-users due to hormonal imbalances and psychological factors. Excessive androgen stimulation is also linked to an increased risk of prostate enlargement, potentially leading to urinary complications.
Conclusion: The long-term use of AAS poses substantial risks to urological health, necessitating awareness and early intervention. Regular medical monitoring and cessation strategies are essential to mitigate these adverse effects. Further research is needed to develop effective rehabilitation and treatment options for individuals experiencing AAS-related urological complications.

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BACKGROUND

The abuse of anabolic-androgenic steroids (AAS) has become a significant global health issue, particularly among athletes and individuals seeking enhanced physical performance and body aesthetics [1]. AAS are synthetic derivatives of testosterone designed to amplify anabolic effects, such as muscle growth and physical strength. However, the use of AAS without medical indication and outside the supervision of healthcare professionals can lead to various adverse effects, including negative impacts on the urological system [2,3].

Physiologically, androgens play a crucial role in the development and function of the male reproductive system, including the regulation of spermatogenesis, libido, and the maintenance of secondary sexual characteristics [4]. Exogenous AAS use can disrupt the body's hormonal balance through negative feedback mechanisms on the hypothalamic-pituitary-gonadal (HPG) axis, ultimately suppressing endogenous testosterone production [5]. This suppression can lead to various urological disorders, such as hypogonadism, infertility, and testicular atrophy [6,7].

Moreover, AAS abuse has been associated with an increased risk of benign prostatic hyperplasia (BPH) and prostate cancer [8]. While androgens are essential for normal prostate growth and function, excessive exogenous androgens can trigger uncontrolled cellular proliferation, thereby increasing the risk of prostate neoplasia [9]. Studies have also indicated that AAS use can lead to erectile dysfunction and decreased libido, significantly affecting an individual's quality of life [10].

This review aims to explore and analyze the latest literature on the long-term urological consequences of AAS abuse. By understanding the pathophysiological mechanisms and clinical implications of AAS use, it is hoped that healthcare practitioners will gain deeper insights into managing patients with a history of AAS abuse and developing effective prevention and intervention strategies.

METHOD

This study is a narrative review aimed at exploring the long-term urological consequences of anabolic-androgenic steroid (AAS) abuse. The review was conducted by searching various scientific literature databases, including PubMed, Scopus, Web of Science, and Google Scholar. The search utilized keywords such as "anabolic androgenic steroids," "urological consequences," "long-term effects," "hypogonadism," "infertility," and "prostate disease," combined with Boolean operators (AND, OR) to ensure broader coverage.

The articles included in this study met specific criteria. Eligible studies were publications in recognized scientific journals, published from 2014 onward, and focused on the long-term effects of AAS abuse on the urological system. Articles available in English or Indonesian were given priority. Conversely, studies that were irrelevant, such as animal-based research, individual case reports without in-depth analysis, and articles that did not directly address urological aspects, were excluded from this review.

Once relevant articles were identified, each study was qualitatively analyzed based on the relevance of findings, methodologies used, and their connection to the research topic. The collected data were then systematically organized to provide a deeper understanding of the long-term impact of AAS on urological health.

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RESULT & DISCUSSION

The abuse of anabolic-androgenic steroids (AAS) has significant long-term effects on urological health, particularly in terms of hypogonadism, infertility, erectile dysfunction, and prostate disorders. Several studies have highlighted the pathophysiological mechanisms involved in these changes, as well as their potential clinical consequences. Table 1 summarizes the main urological effects of AAS abuse, including their underlying mechanisms and associated clinical symptoms.

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Table 1. Urological Effects of AAS

Urological Effect	Mechanism	Clinical Symptoms
Hypogonadism	Suppression of HPG axis	Decreased libido, infertility
Infertility	Disrupted spermatogenesis	Oligospermia, azoospermia
Erectile Dysfunction	Hormonal imbalance	Difficulty in erection, premature ejaculation
Benign Prostatic Hyperplasia	Excess androgen stimulation	Urinary retention, nocturia

Hypogonadism resulting from AAS use is caused by suppression of the hypothalamic-pituitary-gonadal (HPG) axis, leading to reduced gonadotropin secretion and inhibition of endogenous testosterone production [1,2]. A study found that 30% of long-term users developed permanent hypogonadism, even after discontinuing AAS for over a year [11]. Additionally, other research has indicated that low endogenous testosterone levels may increase the risk of osteoporosis and metabolic disorders in former AAS users [12].

Regarding infertility, chronic AAS use suppresses sperm production and decreases semen quality. A study by Christou et al. confirmed that long-term AAS users were three times more likely to develop azoospermia than the general population [5]. Rasmussen et al. also found that former AAS users exhibited lower inhibin B levels, which are associated with impaired spermatogenesis [6]. Other studies have revealed that although discontinuing AAS can restore sperm production, this process may take years and often does not fully recover [13,14].

Erectile dysfunction is another common effect following AAS withdrawal. While exogenous androgens may initially enhance libido, long-term hormonal imbalance leads to sexual dysfunction [10]. A study conducted on 500 former AAS users found that over 60% experienced persistent erectile dysfunction that did not improve with exogenous testosterone therapy [15]. Additionally, AAS-induced vascular effects contribute to erectile dysfunction by inhibiting nitric oxide synthesis, which is essential for the erection mechanism [8]. Table 2 illustrates the prevalence of erectile dysfunction in AAS users across different age groups, showing a clear trend of increasing risk with age compared to non-users.

Table 2. Prevalence of Erectile Dysfunction in AAS Users by Age Group

Age Group	AAS Users (%)	Non-Users (%)
18-25 years	25%	5%
26-35 years	35%	8%
36-45 years	45%	12%
46+ years	50%	15%

Prostate-related complications are also a major concern. AAS increases androgen activity in prostate tissue, potentially triggering benign prostatic hyperplasia (BPH) and raising the risk of prostate cancer [9]. Epidemiological studies have shown that AAS users have larger prostate volumes and a higher risk of urinary retention compared to non-users [16,17]. Furthermore, laboratory studies suggest that AAS can upregulate androgen receptor (AR) expression in prostate tissue, potentially accelerating prostate cancer progression in genetically predisposed individuals [18].

Cardiovascular effects of AAS use may also contribute to urological complications. Recent studies indicate that men who use AAS have a higher risk of hypertension and endothelial dysfunction, which can impair blood flow to reproductive organs and worsen sexual dysfunction [19]. A meta-analysis found that AAS use increases the risk of atherosclerosis by up to 40%, further contributing to vascular dysfunction in the penis [20].

These findings underscore the serious impact of AAS abuse on both the urological system and overall health. Awareness of these risks must be increased, particularly among individuals using AAS for non-medical purposes. Table 3 summarizes the key differences in urological health parameters between AAS users and non-users. Appropriate clinical interventions, including hormonal therapy and rehabilitation, may help mitigate the long-term side effects in former users.

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Table 3. Comparison Between AAS Users and Non-Users

Parameter	AAS Users	Non-Users
Testosterone Levels	Low after AAS cessation	Normal
Spermatogenesis	Impaired, may be reversible	Normal
Prostate Size	Enlarged	Normal
Prevalence of Erectile Dysfunction	High (30-50%)	Low (5-10%)

CONCLUSION

Anabolic-Androgenic Steroids (AAS) have significant effects on urological health, particularly in aspects of hormonal function, fertility, and sexual disorders. AAS use is associated with hypogonadism, infertility due to impaired spermatogenesis, as well as an increased risk of erectile dysfunction and benign prostatic hyperplasia. These effects are primarily caused by the suppression of the hypothalamic-pituitary-gonadal (HPG) axis and the resulting hormonal imbalance.

Clinical studies indicate that AAS users have lower testosterone levels after cessation, reduced sperm count and quality, and a higher prevalence of erectile dysfunction compared to non-users. Additionally, the impact of AAS on prostate function is a concern, particularly the risk of prostatic hyperplasia, which can lead to urinary complications.

With the increasing prevalence of AAS use among athletes and bodybuilders, awareness of its long-term adverse effects is crucial. Strict medical monitoring and education on the risks of AAS use are necessary to prevent further complications. Further research is also needed to evaluate effective rehabilitation and therapeutic strategies for individuals experiencing urological consequences due to AAS.

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