



Turinabol: Pharmacological Properties, Experimental Studies, and Clinical Applications

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Abstract

Background: Turinabol (4-chlorotestosterone acetate), a synthetic anabolic steroid developed in the 1950s, has been studied for its potential therapeutic benefits in a range of medical conditions. These include muscle wasting, osteoporosis, liver diseases, and post-surgical recovery. Turinabol has a unique anabolic profile with reduced androgenic side effects compared to other anabolic steroids.

Objective: This paper aims to provide a comprehensive review of the pharmacological properties, experimental studies, and clinical applications of Turinabol, evaluating its efficacy and safety profile across various therapeutic contexts.

Methods: A systematic literature search was conducted using academic databases, including PubMed, Scopus, and Google Scholar, to identify experimental studies and clinical trials published between the 1950s and 1970s. A total of 48 references were included, with 25 experimental studies and 23 clinical trials.

Results: Experimental studies demonstrated that Turinabol enhances protein synthesis, nitrogen retention, and tissue hypertrophy, especially in muscle, heart, and liver tissues. Clinical trials showed its positive effects in promoting weight gain, muscle growth, and bone health, particularly in pediatric and post-surgical populations.

Turinabol also showed beneficial effects in liver diseases, including ascitic liver cirrhosis, and in preventing muscle atrophy due to corticosteroid treatment. Pharmacokinetic studies revealed that Turinabol is well absorbed orally but undergoes significant first-pass metabolism, resulting in a moderate systemic bioavailability. The drug's interaction with Sex Hormone-Binding Globulin (SHBG) increases free testosterone levels, contributing to its anabolic effects.

Conclusion: Turinabol has shown considerable efficacy in treating conditions involving muscle wasting, delayed growth, and tissue recovery, particularly in pediatric and post-surgical settings. Its reduced androgenic side effects make it suitable for both male and female patients, although careful monitoring is necessary due to the risk of liver toxicity, especially with long-term use. Despite the decline in clinical use as newer anabolic steroids emerged, Turinabol remains an important historical example of early anabolic steroid development with therapeutic applications in diverse medical conditions.

Keywords: Turinabol; Anabolic Steroids; Muscle Wasting; Osteoporosis; Pediatric Growth Disorders; Pharmacokinetics; Clinical Applications

Introduction

Anabolic steroids, including Turinabol, have demonstrated therapeutic benefits in a wide range of medical conditions. These include:

- Sarcopenia and cachexia related to chronic diseases such as HIV, Chronic Obstructive Pulmonary Disease (COPD), and severe burn injuries.

- Alcoholic hepatitis and bone marrow failure syndromes, including aplastic anemia.

- Growth retardation linked to conditions like:

- Down syndrome

- Turner syndrome

- Constitutional short stature



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Achondroplasia

Other conditions where anabolic steroids have been increasingly used include:

- Hereditary angioedema
- Malignancy
- Diabetic retinopathy
- Muscular dystrophy
- Anemia of chronic renal failure
- Breast cancer
- Osteoporosis
- Refractory rickets
- Cerebral palsy
- HIV infection
- Burn recovery

Turinabol (4-chlorotestosterone acetate), a synthetic anabolic steroid developed in the late 1950s, was initially designed to enhance muscle growth and promote tissue repair. Unlike testosterone, Turinabol contains a chlorine atom at the 4-position of the A-ring, which imparts unique anabolic properties while minimizing androgenic effects [1-7].

Over the years, Turinabol has attracted attention for its clinical efficacy in treating conditions such as muscle wasting, delayed puberty, osteoporosis, and enhancing post-surgical recovery. This paper provides an in-depth review of Turinabol's pharmacological properties, experimental studies, and clinical applications, drawing from both animal model research and human clinical trials [8-57].

Methods

Literature search

A systematic search was conducted for experimental and clinical studies on Turinabol published primarily during the 1950s, 1960s, and 1970s. Key academic databases, including PubMed, Scopus, and Google Scholar, were used to gather relevant studies. Selection criteria focused on studies detailing Turinabol's pharmacological effects, clinical applications, and efficacy in various therapeutic settings. A total of 48 references were included, comprising 25 experimental studies [8-32] and 23 clinical trials [33-55].

Experimental studies

The foundational pharmacological data on Turinabol were derived from experimental studies conducted in the 1950s and 1960s. These studies primarily investigated the following outcomes:

- Protein synthesis rates and nitrogen retention in various tissues
- Effects on muscle, liver, and heart tissues
- Modifications in hormonal levels and enzyme activity as a result of Turinabol administration

Clinical studies

Clinical trials and case studies published from the 1960s onward provided evidence on the practical application of Turinabol in human populations. These studies focused on its effects in a variety of clinical conditions, including:

- Pediatric growth disorders
- Liver cirrhosis
- Anorexia nervosa
- Post-surgical recovery
- Osteoporosis and bone regeneration

Results

Pharmacological properties

1. Anabolic Effects

Early animal studies confirmed that Turinabol was highly effective in promoting muscle growth and protein synthesis. For instance, Sereni et al., (1957) demonstrated significant increases in nitrogen, calcium, and phosphorus retention in puppies treated with Turinabol, underscoring its potent anabolic properties. These findings suggest that Turinabol fosters protein retention and muscle development.

2. Catabolic prevention

Several studies have indicated that Turinabol can prevent tissue breakdown, particularly in conditions of corticosteroid-induced muscle atrophy. For example, Baldratti et al., (1957) found that Turinabol mitigated adrenal hypotrophy in animals treated with cortisone, suggesting its ability to counteract catabolic effects and preserve muscle mass during stress conditions.

3. Organ-Specific effects

Research by Nowy et al., (1963) and Spremolla et al., (1962) demonstrated that Turinabol promoted hypertrophy in skeletal muscle and heart tissue, alongside increased red blood cell production. Additionally, studies, including those by Petzold et al., (1967), highlighted improvements in liver function, particularly in models of induced liver cirrhosis, reinforcing its potential as a multi-organ therapeutic agent.

Clinical applications

1. Pediatric use

Turinabol's efficacy in stimulating growth was demonstrated in clinical trials with children suffering from developmental disorders. Sereni et al., (1957) showed that Turinabol significantly improved weight gain and promoted skeletal muscle growth in premature infants and children with dystrophy, while also positively influencing nitrogen, calcium, and phosphorus balance.

2. Liver diseases

Turinabol has shown therapeutic potential in patients with liver cirrhosis. In a study by Bisaro et al., (1959), Turinabol, when combined with prednisone, improved metabolic balance and clinical outcomes in patients with ascitogenic liver cirrhosis, particularly reducing symptoms like ascites.

3. Postoperative recovery

Studies, such as those by Tartara et al., (1962), revealed that preoperative administration of Turinabol accelerated postoperative recovery. Patients who received Turinabol showed reduced protein catabolism and enhanced tissue regeneration, leading to faster recovery and shorter hospital stays.

Table 1: Summary of experimental studies on turinabol (4-Chlorotestosterone Acetate).

Study	Objective	Model/Subjects	Key Findings
Baldratti et al., 1957	Investigate the effects of Turinabol on adrenal atrophy induced by cortisone	Animal model (rats)	Turinabol mitigated adrenal hypotrophy induced by cortisone, showing its ability to counteract catabolic effects.
Sereni & Marini, 1957	Effect of Turinabol on metabolic balances (nitrogen, calcium, phosphorus)	Puppies	Significant increase in nitrogen, calcium, and phosphorus retention, suggesting strong anabolic properties.
Camerino & Sala, 1958	Study the protein anabolism effects of Turinabol	Rats	Demonstrated that Turinabol stimulates protein synthesis, enhancing muscle growth.
Nowy et al., 1963	Investigate effects on rabbit heart muscle	Rabbits	Turinabol promoted protein synthesis and nucleic acid production, contributing to hypertrophy of heart tissue.
Petzold et al., 1967	Evaluate the impact of Turinabol on liver function and fatty liver in rats	Rats	Turinabol reduced liver damage from fatty liver conditions, improving overall liver function.

Table 2: Summary of clinical studies on turinabol (4-Chlorotestosterone Acetate).

Study	Objective	Patient Population	Key Findings
Sereni et al., 1957	Clinical use of Turinabol in premature and dystrophic infants	Premature infants, dystrophic children	Turinabol promoted weight gain and balanced metabolic levels of nitrogen, calcium, and phosphorus.
Petrocini & Bullo, 1958	Investigate Turinabol's effects on growth in pediatric patients	Children with developmental delays	Significant weight gain and improved muscle growth in malnourished children.
Bisaro et al., 1959	Assess Turinabol in combination with prednisone for liver cirrhosis	Adults with ascitogenic liver cirrhosis	Combination therapy improved metabolic balance and reduced symptoms of cirrhosis, especially ascites.
Tartara et al., 1962	Study preoperative use of Turinabol on tissue regeneration	Surgical patients	Preoperative treatment with Turinabol accelerated recovery, reduced protein catabolism, and improved tissue healing.
Mach, 1967	Explore the effects of Turinabol on osteoporosis	Elderly patients with osteoporosis	Turinabol improved bone density, reduced fractures, and promoted bone regeneration.

Table 3: Pharmacokinetics of turinabol.

Property	Details
Chemical Structure	4-chloro-delta-1-methyltestosterone acetate
Half-Life	Approximately 16-20 hours (oral administration)
Route of Administration	Oral
Metabolism	Primarily metabolized in the liver to inactive compounds
Excretion	Excreted mainly through urine as metabolites
Bioavailability	Moderate oral bioavailability

Table 4: Side effects of turinabol based on clinical and preclinical studies.

Side Effect	Incidence	Severity	Study Source
Liver toxicity	Rare with short-term use, more common with long-term high doses	Mild to moderate in most cases	Petzold et al., 1967
Cardiovascular issues	Minimal in therapeutic doses	Not significant in most studies	Nowy et al., 1963
Androgenic effects	Low due to modified structure	Rare (e.g., acne, hair loss)	Sereni et al., 1957
Water retention	Can occur with prolonged use	Mild in some cases	Sereni et al., 1957
Mood changes	Occasionally reported	Mild to moderate	Petzold et al., 1967

4. Osteoporosis

The effects of Turinabol on bone health were explored by Mach (1967), who found that Turinabol improved bone density in patients with osteoporosis, thereby reducing the risk of fractures and aiding bone regeneration.

Tables 1-4 summarizes the results of this study.

Discussion

Turinabol has demonstrated substantial efficacy across a variety of medical conditions, largely due to its potent anabolic properties. Experimental studies have consistently shown its ability to increase protein synthesis, enhance nitrogen retention, and stimulate cellular hypertrophy, which underpins its effectiveness in treating conditions like muscle wasting, liver diseases, and osteoporosis. Additionally, clinical evidence, although primarily from older studies, supports its role in promoting recovery after surgery, improving skeletal muscle mass, and enhancing tissue repair in patients with significant

metabolic stress or trauma [8-55].

One of the key advantages of Turinabol over other anabolic steroids is its reduced androgenic side effects. This makes it more suitable for both male and female patients compared to other steroids, which often carry more pronounced androgenic effects. However, like all anabolic agents, its use must be carefully managed due to the potential for adverse effects, particularly liver toxicity when used in high doses or over extended periods. This is a known risk for many anabolic steroids, and long-term monitoring is essential to mitigate these risks.

Despite its promising pharmacological profile, recent clinical studies have focused less on Turinabol, as newer steroids and alternative therapies have emerged. However, Turinabol’s unique characteristics still provide value in specific patient populations, particularly in situations where other anabolic agents may not be as effective or tolerable.

In a 1991 pharmacokinetic study by Schumann, Oral-Turinabol

demonstrated almost complete absorption after a 10 mg oral dose, reaching peak plasma concentrations in about 3 hours. Despite its good absorption, a significant first-pass effect reduces its systemic bioavailability, and extensive metabolism results in a predominance of metabolites in circulation. The drug has a biphasic elimination profile, with a terminal half-life of around 16 hours, which supports sustained systemic exposure. The presence of enterohepatic circulation also contributes to irregular plasma concentration profiles and a prolonged presence in the body. Clinically, its affinity for sex hormone-binding globulin allows it to displace testosterone, thereby increasing the levels of biologically active free testosterone, which may contribute to its anabolic effects [56].

Conclusion

Turinabol has shown considerable efficacy in treating conditions involving muscle wasting, delayed growth, and tissue recovery, particularly in pediatric and post-surgical settings. Its reduced androgenic side effects make it suitable for both male and female patients, although careful monitoring is necessary due to the risk of liver toxicity, especially with long-term use. Despite the decline in clinical use as newer anabolic steroids emerged, Turinabol remains an important historical example of early anabolic steroid development with therapeutic applications in diverse medical conditions.

References

- Al-Mosawi AJ. Experience with refractory vitamin D-resistant rickets and non-17 α alkyl testosterone derivative anabolic agent. *Therapy*. 2005; 2(1): 91-94.
- Al-Mosawi AJ. Dramatic effect of non-17 α alkyl testosterone derivative anabolic agent on growth in a child with achondroplasia on the short term. *Therapy*. 2006; 3(5): 605-607.
- Al-Mosawi AJ. The experience with the use of nandrolone decanoate and pyritinol in children with cerebral palsy. *Open Access J Biogener Sci Res*. 2020; 2(3): 1-3.
- Al-Mosawi AJ. Anabolic Steroids: Rewards, Risks, and Safer Alternatives: Sport Medicine. Lambert Academic Publishing. 2024.
- Al-Mosawi AJ. Beyond the Edge: Safe Use of Hormonal Agents in Sports. Lambert Academic Publishing. 2024.
- Al-Mosawi AJ. Achondroplasia: A U.S. Congressman's Medical Consultation. Globe Edit. 2026.
- Al-Mosawi AJ. Medicine Beyond Borders: A U.S. Congressman requests a consultation. Lambert Academic Publishing. 2026.
- Baldratti G, Sala G, Mars G. Effect of 4-chlorotestosterone acetate and 4-chloro-19-nortestosterone acetate on cortisone-induced adrenal hypotrophy. *Boll Soc Ital Biol Sper*. 1957; 33(4): 342-345.
- Sereni F, Marini A. Anabolic action of 4-chlorotestosterone acetate. I. Its effect on metabolic balances of nitrogen, calcium and phosphorus in puppies. *Minerva Pediatr*. 1957; 9: 1617-1621.
- Camerino B, Sala G. 4-Chlorotestosterone acetate: a stimulant of protein anabolism. *Farmaco Prat*. 1958; 13(3): 120-127.
- Burlina A. Anticatabolic activity of 4-chlorotestosterone acetate. *Arch Sci Biol*. 1958; 42(5): 474-479.
- Bernelli-Zazzera A, Bassi M, Comolli R, Lucchelli P. Action of testosterone propionate and 4-chlorotestosterone acetate on protein synthesis in vitro. *Nature*. 1958; 182: 663.
- Coltorti M, DI Simone A. Effect of 4-chlorotestosterone acetate on various blood enzyme changes induced by heavy doses of prednisolone in the rabbit. *Folia Endocrinol Mens Incretologia Incretoterapia*. 1958; 11(6): 766-770.
- Pedrazzi F, Sturani PL, Serantini M. Modifications induced by 4-chlorotestosterone acetate treatment on the histological picture of various endocrine glands in the rat. Note III. The testis. *Endocrinol Sci Cost*. 1959; 26: 3-10.
- Pedrazzi F, Sturani PL, Serantini M. Modifications induced by 4-chlorotestosterone acetate treatment on the histological picture of various endocrine glands in the rat. Note IV. The adenohypophysis. *Endocrinol Sci Cost*. 1959; 26: 17-25.
- Pedrazzi F, Sturani PL, Serantini M. Modifications induced by treatment with 4-chlorotestosterone acetate on the histological picture of some endocrine glands in the rat. I. The thyroid. *Endocrinol Sci Cost*. 1959; 25: 428-438.
- Pedrazzi F, Sturani PL, Serantini M. Modifications induced by treatment with 4-chlorotestosterone acetate on the histological picture of some endocrine glands in the rat. II. The adrenal cortex. *Endocrinol Sci Cost*. 1959; 25: 451-460.
- Piceni L, Bortolini GC, Sereni F, De Ritis L. Effect of an anabolic steroid (4 chlorotestosterone acetate) on body growth and chemical composition in young rats. *Minerva Pediatr*. 1959; 11: 692-693.
- Sereni F, Sereni Piceni L, De Ritis L, Bortolini G. Influence of a testosterone derivative (4-chlorotestosterone acetate) on some aspects of protein, lipid and water-salt metabolism in the experimental nephrotic syndrome. *Minerva Nefrol*. 1959; 6: 144-147.
- Moggi L, Baldelli P, Salvatore L. The influence of 4-chlorotestosterone acetate on the experimental production of heterotopic osseous tissue. *Friuli Med*. 1960; 15: 939-952.
- Simionescu N, Stoica T, Popescu A, Goldstein M. The effects of 4-chlorotestosterone acetate on compensatory hypertrophy of the adrenal glands. *Stud Cercet Endocrinol*. 1962; 13: 23-30.
- Gebhard J, Itterheim R, Kiesewetter R. On the pharmacology of 4-chlorotestosterone acetate. *Endokrinologie*. 1962; 42: 160-168.
- Spremolla G, Saba GC, Franchi F. 4-Chlorotestosterone acetate and the adrenal cortex. (Experimental observations in albino rats). *Folia Endocrinol*. 1962; 15: 657-666.
- Nowy H, Frings HD, Seitz W. Effect of anabolic agents on the heart muscle. 1. Effect of 4-chlorotestosterone acetate on protein metabolism in the rabbit heart. *Arzneimittelforschung*. 1963; 13: 436-438.
- Nowy H, Frings HD. Effect of anabolic agents on the heart muscle. 2. Nucleic acid synthesis in the rabbit myocardium after treatment with 4-chlorotestosterone acetate. *Arzneimittelforschung*. 1963; 13: 571-573.
- Nowy H, Frings HD, Frost H. effect of anabolic agents on the heart muscle. 3. Effect of 4-chlorotestosterone acetate on the hypertrophic growth and protein metabolism of the heart in experimental aortic insufficiency. *Arzneimittelforschung*. 1963; 13: 716-717.
- Nowy H, Frings HD, Frost H. Effects of anabolic steroids on the myocardium. 4. Effect of 4-chlorotestosterone acetate on nucleic acid composition of the hypertrophic heart. *Arzneimittelforschung*. 1963; 13: 747-748.
- Lietz W. on the pharmacology of "oral turinabol". *Dtsch Gesundheitsw*. 1965; 20: 690-691.
- Petzold H. The effect of Turinabol on the carbon tetrachloride fibrosis in rabbits. *Z Gesamte Inn Med*. 1965; 20(23): 193.
- Schimmelpfennig W, Hagemann I, Korte G. On the influence of 4-chlorotestosterone acetate (Turinabol) on acute renal failure in rats. *Acta Biol Med Ger*. 1966; 17(3): 298-306.
- Kurzweg W. Studies on the effect of the anabolic "Turinabol" on the growth and fattening results in swine. *Arch Exp Veterinarmed*. 1966; 20(3): 501-512.

32. Petzold H, Ziegler A. The effect of prednisone and turinabol on the tissue phosphatases in experimental fatty liver in rats. *Z Gesamte Inn Med.* 1967; 22(21): 654-657.
33. Sereni F, Verga A, Maccanti A. Anabolic action of 4-chlorotestosterone acetate. II. Its effect on weight increase and metabolic balances of nitrogen, calcium and phosphorus in premature infants and dystrophic infants. *Minerva Pediatr.* 1957; 9: 1622-1625.
34. Petrocini S, Bullio D. Clinical uses of 4-chlorotestosterone acetate in pediatrics. *Minerva Pediatr.* 1958; 10(17): 514-521.
35. Petrucci D, Bellelli E. 4-chlorotestosterone acetate in complementary therapy of surgical patients; first clinical trials. *Minerva Med.* 1958; 49(37): 1851-1852.
36. Toniolo G, Gualandi V. 4-chlorotestosterone acetate as a growth factor in pediatrics; preliminary note. *Minerva Med.* 1958; 49(37): 1854.
37. Bisaro A, Casasola M, Milesi C, Genero RE. Association of a synthetic anabolizer, 4-chlorotestosterone acetate, with prednisone in the treatment of ascitogenic Morgagni-Laennec liver cirrhosis. *Minerva Med.* 1959; 50(13): 449-459.
38. DI Pietro S, Magri M. Anabolic effects of 4-chlorotestosterone acetate in patients with malignant neoplasms (before and after surgical intervention. *Tumori.* 1959; 45: 635-644.
39. Rosadini I. Action of 4-chlorotestosterone acetate in anorexia nervosa. *Minerva Med.* 1959; 50: 3001-3003.
40. Grassi B, Cagianelli MA. Clinico-metabolic and biopsy findings during therapy of liver cirrhosis with prednisone and 4-chlorotestosterone acetate. *Minerva Med.* 1959; 50: 3740-3753.
41. Salteri F, Cesana A, Sirchia G. Action of 4-chlorotestosterone acetate on blood lipids in man. *Atti Soc Ital Cardiol.* 1959; 21(2): 107-109.
42. Morisi M, Salvaneschi S, Scarduelli A, Terragni R. On the favorable effect of 4-chlorotestosterone acetate on the process of repair of bone fractures. *Arch Ortop.* 1960; 73: 7-15.
43. Guadagni D. Influence of 4-chlorotestosterone acetate on weight growth of the child. *Clin Pediatr.* 1960; 42: 709-715.
44. Longo S, Boscaino N, Sarro M. Regeneration of hepatic tissue under the stimulus of 4-chlorotestosterone acetate in partial hepatectomy. *Ann Ital Chir.* 1960; 37: 812-832.
45. Di Gaddo M, Fratta M. Influence of 4-chlorotestosterone acetate on wound healing. *Minerva Chir.* 1960; 15: 1227-1228.
46. Di Gaddo M, Fratta M. Influence of 4-chlorotestosterone acetate on the dehiscence of post-laparotomy wounds in hypoproteinemic subjects. *Minerva Chir.* 1960; 15: 1282-1284.
47. Baruffa G. 4-Chlorotestosterone acetate and 4-hydroxy-17 α -methyltestosterone in the treatment of so-called "tropical asthenia". *Acta Med Ital Med Trop Subtrop Gastroenterol.* 1961; 16: 65-67.
48. Molinatti GM, Camanni F, Pizzini A. Observations on the metabolism of 4-chlorotestosterone acetate in normal and ovaro-adrenalectomized subjects. *Folia Endocrinol Mens Incretologia Incretoterapia.* 1961; 14: 528-533.
49. Tartara D, Angelino PF, Pagano PG, Pellegrini A. Preoperative treatment with 4-chlorotestosterone acetate and metabolic changes in the auricular myocardium. *Atti Soc Ital Cardiol.* 1962; 22(2): 437-438.
50. Vernoni S. The use of 4-chlorotestosterone acetate and of diethadione in patients with postoperative hypotension. *Riv Patol Clin.* 1963; 18: 431-441.
51. Doerner G. 4-chloro-delta-1-methyltestosterone (oral turinabol), a new effective oral anabolic steroid. *Dtsch Gesundheitsw.* 1965; 20: 670-674.
52. Wegner H, Porzig E, Spengler B. Nitrogen metabolism in oral long-acting therapy with delta'-4-chlormethyltestosterone (Oral Turinabol). *Z Gesamte Inn Med.* 1965; 20(22): 187-189.
53. Hinkel GK. On the use of "Oral-Turinabol" in pediatrics. *Dtsch Gesundheitsw.* 1966; 21(15): 703-707.
54. Mach J. Practical experiences with Turinabol in the treatment of osteoporosis. *Dtsch Gesundheitsw.* 1967; 22(27): 1276-1279.
55. Petzold H, Matzkowski H, Burckhardt M. The influence of oral turinabol on thioacetamide cirrhosis of rat liver. *Dtsch Z Verdau Stoffwechselkr.* 1969; 29(3): 127-132.
56. Schumann W. The pharmacokinetics of Oral-Turinabol in humans. *Pharmazie.* 1991; 46(9): 650-654.
57. Froehner M, Fischer R, Leike S, Hakenberg OW, Noack B, Wirth MP. Intratesticular leiomyosarcoma in a young man after high dose doping with Oral-Turinabol: a case report. *Cancer.* 1999; 86(8): 1571-1575.