3. Barrett-Connor E, *et al.* Effects of raloxifene on cardiovascular events and breast cancer in postmenopausal women. *N Engl J Med* 2006; **355:** 125–37.
4. Lippman ME, *et al.* Effect of raloxifene on the incidence of invasive breast cancer in postmenopausal women with osteoporosis categorized by breast cancer risk. *Clin Cancer Res* 2006; **12:** 5242–7.
5. Vogel VG, *et al.* Effects of tamoxifen vs raloxifene on the risk of developing invasive breast cancer and other disease outcomes: the NSABP Study of Tamoxifen and Raloxifene (STAR) P-2 trial. *JAMA* 2006; **295:** 2727–41. Corrections. *ibid.*; **296:** 2926 and *ibid.* 2007; **298:** 973.

Osteoporosis. Raloxifene partially mimics the effects of oestrogens in bone to increase bone mineral density in postmenopausal women.[1,2] The MORE study in 7705 postmenopausal women with osteoporosis (p.1084) found that up to 4 years of raloxifene treatment reduced the risk of vertebral fracture,[3-6] but the risk of nonvertebral fracture did not differ significantly from that in women given placebo.[3,5] A meta-analysis[7] of data from this and other smaller studies concluded that raloxifene reduced the risk of vertebral fracture by between 40 and 49% in postmenopausal women with osteoporosis.

Small studies suggest that raloxifene may be effective as 'add-back' therapy to prevent the loss of bone mineral density associated with gonadorelin analogue therapy in women[8,9] and men.[10]

1. Clemett D, Spencer CM. Raloxifene: a review of its use in postmenopausal osteoporosis. *Drugs* 2000; **60:** 379–411.
2. Cranney A, Adachi JD. Benefit-risk assessment of raloxifene in postmenopausal osteoporosis. *Drug Safety* 2005; **28:** 721–30.
3. Ettinger B, *et al.* Multiple Outcomes of Raloxifene Evaluation Investigators. Reduction of vertebral fracture risk in postmenopausal women with osteoporosis treated with raloxifene: results from a 3-year randomized clinical trial. *JAMA* 1999; **282:** 637–45.
4. Maricic M, *et al.* Early effects of raloxifene on clinical vertebral fractures at 12 months in postmenopausal women with osteoporosis. *Arch Intern Med* 2002; **162:** 1140–3.
5. Delmas PD, *et al.* Multiple Outcomes of Raloxifene Evaluation Investigators. Efficacy of raloxifene on vertebral fracture risk reduction in postmenopausal women with osteoporosis: four-year results from a randomized clinical trial. *J Clin Endocrinol Metab* 2002; **87:** 3609–17.
6. Qu Y, *et al.* The effect of raloxifene therapy on the risk of new clinical vertebral fractures at three and six months: a secondary analysis of the MORE trial. *Curr Med Res Opin* 2005; **21:** 1955–9.
7. Seeman E, *et al.* Anti-vertebral fracture efficacy of raloxifene: a meta-analysis. *Osteoporos Int* 2006; **17:** 313–16.
8. Palomba S, *et al.* Raloxifene administration in women treated with gonadotropin-releasing hormone agonist for uterine leiomyomas: effects on bone metabolism. *J Clin Endocrinol Metab* 2002; **87:** 4476–81.
9. Palomba S, *et al.* Long-term effectiveness and safety of GnRH agonist plus raloxifene administration in women with uterine leiomyomas. *Hum Reprod* 2004; **19:** 1308–14.
10. Smith MR, *et al.* Raloxifene to prevent gonadotropin-releasing hormone agonist-induced bone loss in men with prostate cancer: a randomized controlled trial. *J Clin Endocrinol Metab* 2004; **89:** 3841–6.

Preparations

USP 31: Raloxifene Hydrochloride Tablets.

Proprietary Preparations (details are given in Part 3)
Arg.: Biofem†; Ciclotran†; Evista; Ketidin; Loxifen†; Oseofem; Raxeto; ***Austral.:*** Evista; ***Austria:*** Evista; ***Belg.:*** Evista; ***Braz.:*** Evista; ***Canad.:*** Evista; ***Chile:*** Evista; ***Cz.:*** Evista; Optruma; ***Denm.:*** Evista; ***Fin.:*** Evista; Optruma†; ***Fr.:*** Evista; Optruma; ***Ger.:*** Evista; Optruma; ***Gr.:*** Evista; ***Hong Kong:*** Evista; ***Hung.:*** Evista; ***India:*** Bonmax; Estroact; Ralista; ***Indon.:*** Evista; ***Irl.:*** Evista; ***Israel:*** Evista; ***Ital.:*** Evista; Optruma; ***Jpn:*** Evista; ***Malaysia:*** Evista; ***Mex.:*** Evista; ***Neth.:*** Evista; Optruma; ***Norw.:*** Evista; ***NZ:*** Evista; ***Philipp.:*** Evista; ***Pol.:*** Evista; ***Port.:*** Evista; Optruma; ***S.Afr.:*** Evista; ***Singapore:*** Evista; ***Spain:*** Evista; Optruma; ***Swed.:*** Evista; ***Switz.:*** Evista; ***Thai.:*** Celvista; ***Turk.:*** Evista; ***UK:*** Evista; ***USA:*** Evista; ***Venez.:*** Evista.

Stanozolol *(BAN, USAN, rINN)* ⊗

Androstanazol; Androstanazole; Estanazol; Estanozolol; Methylstanazole; Metistanazol; NSC-43193; Stanotsololi; Stanozololis; Stanozololum; Stanozolum; Sztanozolol; Win-14833. 17α-Methyl-2′*H*-5α-androst-2-eno[3,2-*c*]pyrazol-17β-ol.

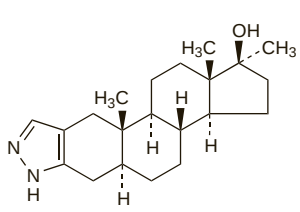
Станозолол

$C_{21}H_{32}N_2O$ = 328.5.

CAS — 10418-03-8.

ATC — A14AA02.

ATC Vet — QA14AA02.



NOTE. The following terms have been used as 'street names' (see p.vi) or slang names for various forms of stanozolol:
Iron Brew.

Pharmacopoeias. In *Chin.* and *US.*

USP 31 (Stanozolol). An odourless crystalline powder occurring in 2 forms; needles melt at about 155° and prisms at about 235°. Insoluble in water; soluble 1 in 41 of alcohol, 1 in 74 of chloroform, and 1 in 370 of ether; slightly soluble in acetone and in ethyl acetate; soluble in dimethylformamide; very slightly soluble in benzene. Store in airtight containers. Protect from light.

Adverse Effects and Precautions

As for androgens and anabolic steroids in general (see Testosterone, p.2130). As with other 17α-alkylated compounds stanozolol may produce hepatotoxicity, and liver function should be monitored. It is probably best avoided in patients with hepatic impairment, and certainly if this is severe. Haematocrit and haemoglobin concentrations should also be monitored.

Because of its androgenic effects it has been recommended that stanozolol should not be used to treat hereditary angioedema in premenopausal women except in life-threatening situations.

Effects on the kidney. Renal failure with cholestatic jaundice has been reported with stanozolol (see below).

Effects on the liver. Cholestatic jaundice has been reported with stanozolol,[1-3] in some cases with acute tubular necrosis and renal failure.[4]

1. Slater SD, *et al.* Jaundice induced by stanozolol hypersensitivity. *Postgrad Med J* 1976; **52:** 229–32.
2. Evely RS, *et al.* Severe cholestasis associated with stanozolol. *BMJ* 1987; **294:** 612–13.
3. Martínez B, *et al.* Colestasis inducida por consumo de estanozolol. *Rev Esp Enferm Dig* 2006; **98:** 219–20.
4. Yoshida EM, *et al.* At what price, glory? Severe cholestasis and acute renal failure in an athlete abusing stanozolol. *Can Med Assoc J* 1994; **151:** 791–3.

Effects on the nervous system. Benign intracranial hypertension developed in an elderly woman receiving stanozolol; CSF pressure returned to normal after stanozolol was stopped.[1]

1. Tully MP, *et al.* Intracranial hypertension associated with stanozolol. *DICP Ann Pharmacother* 1990; **24:** 1234.

Porphyria. Stanozolol is considered to be unsafe in patients with porphyria because it has been shown to be porphyrinogenic in *animals*.

Interactions

As mentioned under Testosterone, p.2131, anabolic steroids may enhance the activity of a number of drugs. For the effect of stanozolol on some anticoagulants, see p.1431.

Uses and Administration

Stanozolol has anabolic and androgenic properties (see Testosterone, p.2131). As with other anabolic steroids, stanozolol has been used for breast cancer in postmenopausal women, and for anaemias, osteoporosis, and catabolic disorders. It has been given in oral doses of 2 mg every 8 to 12 hours, or 50 mg by intramuscular injection every 2 or 3 weeks.

In the management of hereditary angioedema, an initial oral dose of 2.5 to 10 mg daily has been given to prevent attacks. The dosage may then be reduced, according to the patient's response; maintenance doses of 2 mg daily or on alternate days, or 2.5 mg three times weekly have been used successfully. For doses that have been used in children, see below.

Administration in children. Androgens are usually avoided in children with hereditary angioedema (below) because of their adverse effects, but they have been used when other treatments are ineffective. In the USA oral doses of stanozolol 1 mg daily, given only during an attack, have been used in children under 6 years of age, and up to 2 mg daily in those aged 6 to 12 years. Slightly higher doses have been permitted in children in the UK.

Hereditary angioedema. Stanozolol raises serum concentrations of C1 esterase inhibitor and has been used successfully to prevent attacks of hereditary angioedema (p.1081).

References.

1. Bowen T, *et al.* Canadian 2003 international consensus algorithm for the diagnosis, therapy, and management of hereditary angioedema. *J Allergy Clin Immunol* 2004; **114:** 629–37.
2. Zuraw BL. Current and future therapy for hereditary angioedema. *Clin Immunol* 2005; **114:** 10–16.
3. Gompels MM, *et al.* C1 inhibitor deficiency: consensus document. *Clin Exp Immunol* 2005; **139:** 379–94. Correction. *ibid.*; **141:** 189–90. [dose]

Vascular disorders. Stanozolol has been used in the treatment of vascular manifestations of Behçet's syndrome. It has also been reported to promote fibrinolysis in vascular disorders, and has been tried in various conditions. However, most studies have been noncomparative and in small numbers of patients, and results have been variable.

Preparations

BP 2008: Stanozolol Tablets;
USP 31: Stanozolol Tablets.

Proprietary Preparations (details are given in Part 3)
Gr.: Stromba; ***India:*** Menabol; Neurabol; ***Irl.:*** Stromba†; ***Spain:*** Winstrol; ***Thai.:*** Stanol†; ***USA:*** Winstrol†.

Multi-ingredient: ***Thai.:*** Cetabon.

Testis Extracts ⊗

Extractos testiculares; Testicular Extracts.

Тестикулярный Экстракт

Profile

Testis extracts are usually of bovine origin and have been used in a variety of disorders. They have been given to elderly men as androgenic supplements. They have also been used topically, often in preparations containing other mammalian tissue extracts, in the treatment of peripheral circulatory or musculoskeletal disorders.

Preparations

Proprietary Preparations (details are given in Part 3)
Ger.: Orchibion†.

Multi-ingredient: ***Canad.:*** ratio-Heracline; ***Ger.:*** poliomyelan†; tactunerval†; ***Hong Kong:*** Wari-Procomil; ***Thai.:*** Wari-Procomil†.

Testosterone *(BAN, rINN)* ⊗

Testosteron; Testosterona; Testosteronas; Testostérone; Testosteroni; Testosteronum; Tesztoszteron. 17β-Hydroxyandrost-4-en-3-one.

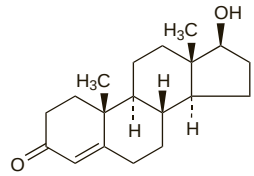
Тестостерон

$C_{19}H_{28}O_2$ = 288.4.

CAS — 58-22-0.

ATC — G03BA03.

ATC Vet — QG03BA03.



NOTE. The following terms have been used as 'street names' (see p.vi) or slang names for various forms of testosterone:
T-Stoff.

Pharmacopoeias. In *Eur.* (see p.vii) and *US.*

Ph. Eur. 6.2 (Testosterone). A white or almost white, crystalline powder, or colourless or yellowish-white crystals. Practically insoluble in water and in fatty oils; freely soluble in alcohol and in dichloromethane. Protect from light.

USP 31 (Testosterone). White or slightly creamy-white, odourless, crystals or crystalline powder. Practically insoluble in water; soluble 1 in 6 of dehydrated alcohol, 1 in 2 of chloroform, and 1 in 100 of ether; soluble in dioxan and in vegetable oils. Store at a temperature of 25°, excursions permitted between 15° and 30°.

Testosterone Cipionate *(BANM, rINNM)* ⊗

Cipionato de testosterona; Testostérone, Cipionate de; Testosterone Cyclopentylpropionate; Testosterone Cypionate; Testosteroni Cipionas. 3-Oxoandrost-4-en-17β-yl 3-cyclopentylpropionate; 17β-Hydroxyandrost-4-en-3-one cyclopentanepropionate; 17β-(3-Cyclopentyl-1-oxopropoxy)androst-4-en-3-one.

Тестостерона Ципионат

$C_{27}H_{40}O_3$ = 412.6.

CAS — 58-20-8.

ATC — G03BA03.

ATC Vet — QG03BA03.

Pharmacopoeias. In *US.*

USP 31 (Testosterone Cypionate). A white or creamy-white, crystalline powder, odourless or has a slight odour. Insoluble in water; freely soluble in alcohol, in chloroform, in dioxan, and in ether; soluble in vegetable oils. Protect from light.

Testosterone Decanoate *(BANM, rINNM)* ⊗

Decanoato de testosterona; Testosteron Dekanoat; Testostérone, décanoate de; Testosteroni decanoas. 3-Oxoandrost-4-en-17β-yl decanoate; 17β-Hydroxyandrost-4-en-3-one decanoate.

Тестостерона Деканоат

$C_{29}H_{46}O_3$ = 442.7.
CAS — 5721-91-5.
ATC — G03BA03.
ATC Vet — QG03BA03.

Pharmacopoeias. In *Eur.* (see p.vii).
Ph. Eur. 6.2 (Testosterone Decanoate). A white or almost white powder. Practically insoluble in water; very soluble in anhydrous alcohol, in acetone, and in dichloromethane; freely soluble in fatty oils. Store at a temperature of 2° to 8°.

Testosterone Enantate *(BANM, rINNM)* ⊗

Enantato de testosterona; NSC-17591; Testosteron enantát; Testostérone, enantate de; Testosterone Enanthate; Testosterone Heptanoate; Testosterone Heptylate; Testosteronenantat; Testosteroni enantas; Testosteronienantaatti; Testosterono enantatas; Testosteronu enantan; Tesztoszteronönantát. 3-Oxoandrost-4-en-17β-yl heptanoate; 17β-Hydroxyandrost-4-en-3-one heptanoate.

Тестостерона Энантат

$C_{26}H_{40}O_3$ = 400.6.
CAS — 315-37-7.
ATC — G03BA03.
ATC Vet — QG03BA03.

Pharmacopoeias. In *Eur.* (see p.vii), *Int.*, *Jpn*, and *US*.
Ph. Eur. 6.2 (Testosterone Enantate). A white or yellowish-white crystalline powder. Practically insoluble in water; very soluble in dehydrated alcohol; freely soluble in fatty oils. Store at a temperature of 2° to 8°. Protect from light.
USP 31 (Testosterone Enanthate). A white or creamy-white crystalline powder. It is odourless or has a faint odour characteristic of heptanoic acid. Insoluble in water; very soluble in ether; soluble in vegetable oils. Store in a cool place.

Testosterone Isocaproate *(BANM, rINNM)* ⊗

Isocaproato de testosterona; Testosteron Isokaproat; Testostérone, isocaproate de; Testosterone Isohexanoate; Testosteroni isocaproas. 3-Oxoandrost-4-en-17β-yl 4-methylpentanoate; 17β-Hydroxyandrost-4-en-3-one 4-methylpentanoate.

Тестостерона Изокапронат

$C_{25}H_{38}O_3$ = 386.6.
CAS — 15262-86-9.
ATC — G03BA03.
ATC Vet — QG03BA03.

Pharmacopoeias. In *Eur.* (see p.vii).
Ph. Eur. 6.2 (Testosterone Isocaproate). A white or almost white powder. Practically insoluble in water; very soluble in acetone and in dichloromethane; freely soluble in fatty oils.

Testosterone Phenylpropionate *(BANM, rINNM)* ⊗

Fenilpropionato de testosterona; Testosteron Fenilpropiyonat; Téstosterone, Phénylpropionate de; Testosteroni Phenylpropionas. 3-Oxoandrost-4-en-17β-yl 3-phenylpropionate; 17β-Hydroxyandrost-4-en-3-one 3-phenylpropionate.

Тестостерона Фенилпропионат

$C_{28}H_{36}O_3$ = 420.6.
CAS — 1255-49-8.
ATC — G03BA03.
ATC Vet — QG03BA03.

Pharmacopoeias. In *BP(Vet)*.
BP(Vet) 2008 (Testosterone Phenylpropionate). A white to almost white crystalline powder. Practically insoluble in water; sparingly soluble in alcohol. Protect from light.

Testosterone Propionate *(BANM, rINNM)* ⊗

NSC-9166; Propionato de testosterona; Testosteron Propiyonat; Testostérone, propionate de; Testosteroni propionas; Testosteronipropionaatti; Testosterono propionatas; Testosteronpropionat; Testosteron-propionát; Testosteronu propionian; Tesztoszteronpropionát. 3-Oxoandrost-4-en-17β-yl propionate; 17β-Hydroxyandrost-4-en-3-one propionate.

Тестостерона Пропионат

$C_{22}H_{32}O_3$ = 344.5.
CAS — 57-85-2.
ATC — G03BA03.
ATC Vet — QG03BA03.

Pharmacopoeias. In *Chin.*, *Eur.* (see p.vii), *Int.*, *Jpn*, and *US*.
Ph. Eur. 6.2 (Testosterone Propionate). A white or almost white powder or colourless crystals. Practically insoluble in water; freely soluble in alcohol and in acetone; soluble in fatty oils.
USP 31 (Testosterone Propionate). White or creamy-white, odourless, crystals or crystalline powder. Insoluble in water; freely soluble in alcohol, in dioxan, in ether, and in other organic solvents; soluble in vegetable oils. Protect from light.

Testosterone Undecylate *(rINNM)* ⊗

Org-538; Testosteron Undekanoat; Testosterone Undecanoate *(BANM, USAN)*; Testostérone, Undécylate de; Testosteroni Undecylas; Undecilato de testosterona. 3-Oxoandrost-4-en-17β-yl undecanoate; 17β-Hydroxyandrost-4-en-3-one undecanoate.

Тестостерона Ундесилат

$C_{30}H_{48}O_3$ = 456.7.
CAS — 5949-44-0.
ATC — G03BA03.
ATC Vet — QG03BA03.

Pharmacopoeias. In *Chin.*

Adverse Effects

Testosterone and other **androgens** may give rise to adverse effects related to their androgenic or anabolic activities. These include increased retention of sodium and water, oedema, hypercalcaemia, and impaired glucose tolerance. Other effects include increased low-density-lipoprotein cholesterol, decreased high-density-lipoprotein cholesterol, increased haematocrit, and suppression of clotting factors. Androgens may cause headache, depression, and gastrointestinal bleeding. It has been suggested that androgens may induce sleep apnoea in susceptible patients.

Abnormal liver function tests may occur and there have been reports of liver toxicity including jaundice and cholestatic hepatitis. There have also been reports of peliosis hepatis and hepatic tumours in patients who have received high doses over prolonged periods. These adverse hepatic effects have occurred primarily with the 17α-alkylated derivatives (e.g. methyltestosterone, stanozolol).

In men, large doses suppress spermatogenesis and cause testicular atrophy. Epididymitis and bladder irritability can occur. Priapism is a sign of excessive dosage and may occur especially in elderly males. Gynaecomastia may occur. Androgens may cause prostatic hyperplasia and accelerate the growth of malignant neoplasms of the prostate.

In women, the inhibitory action of androgens on the activity of the anterior pituitary results in the suppression of ovarian activity and menstruation. Continued use produces symptoms of virilism, such as hirsutism or male-pattern baldness, deepening of the voice, atrophy of the breasts and endometrial tissue, oily skin, acne, and hypertrophy of the clitoris. Virilisation may not be reversible, even after stopping therapy.

Large and repeated doses in early puberty may cause closure of the epiphyses and stop linear growth. Children may experience symptoms of virilisation: in boys there may be precocious sexual development with phallic enlargement and increased frequency of erection, and in girls, clitoral enlargement. Gynaecomastia may also occur in boys.

Masculinisation of the external genitalia of the female fetus may occur if androgens are given during pregnancy.

After transdermal application of testosterone, skin reactions may include irritation, erythema, allergic contact dermatitis, and sometimes burn-like lesions. Skin reactions are more common with patches that contain permeation enhancers.

The **anabolic steroids**, because they generally retain some androgenic activity, share the adverse effects of the androgens described above, but their virilising effects, especially in women, are usually less. There have been reports of adverse psychiatric effects in athletes taking large doses to try and improve performance. For adverse effects following the misuse of anabolic steroids, see Abuse under Precautions, below.

Carcinogenicity. Testosterone therapy is used in healthy older men with low or low-normal serum-testosterone concentrations (see Hypogonadism, under Uses and Administration, below), but there is some concern about a possible associated increase in prostate cancer risk. This concern is based on the fact that, regardless of any treatment, the incidence of prostate cancer increases with age, that normal prostate growth is dependent on androgens, and that androgen deprivation causes regression of advanced prostate cancer.[1] However, the relationship between androgens and the onset of prostate cancer is far from clear. Some data show that low serum-testosterone can predict more aggressive high-grade tumours, with a higher likelihood of metastatic disease and poorer outcome.[1,2] Although there have been reports of prostate cancer developing in men who have been treated with testosterone,[3] small clinical studies have, overall, not shown an increase in the risk of prostate cancer.[4] The effect of 6 months of testosterone enantate therapy on the prostate has been studied in 21 ageing men.[5] Although low serum-testosterone concentrations were normalised, there were no significant changes in androgen concentrations in prostate tissue, prostate volume, prostate specific antigen, or prostate cancer incidence. Further study of longer duration in larger numbers of men is needed to confirm the safety of this therapy.

In men with a history of prostate cancer, testosterone therapy for hypogonadism is generally contra-indicated because of the presumed risk of tumour recurrence. However, there are a small number of reports of testosterone being used safely after curative surgery, suggesting that testosterone therapy with close monitoring may be considered in such men with symptomatic hypogonadism.[6] There is even less data on the use of testosterone for hypogonadism in men who have been treated with radiotherapy with curative intent, or with androgen ablation by gonadorelin analogue therapy. Testosterone has also been used for hypogonadism in a small number of men with high-grade intra-epithelial neoplasia, a precancerous lesion, without increasing the risk of cancer development.[6]

For reference to hepatic malignancies associated with androgens and anabolic steroids, see Effects on the Liver, below. Renal cell carcinoma has also been reported after their abuse (see under Precautions, below).

1. Raynaud J-P. Prostate cancer risk in testosterone-treated men. *J Steroid Biochem Mol Biol* 2006; **102:** 261–6.
2. Barqawi A, Crawford ED. Testosterone replacement therapy and the risk of prostate cancer: is there a link? *Int J Impot Res* 2006; **18:** 323–8.
3. Brand TC, *et al*. Testosterone replacement therapy and prostate cancer: a word of caution. *Curr Urol Rep* 2007; **8:** 185–9.
4. Gould DC, Kirby RS. Testosterone replacement therapy for late onset hypogonadism: what is the risk of inducing prostate cancer? *Prostate Cancer Prostatic Dis* 2006; **9:** 14–18.
5. Marks LS, *et al.* Effect of testosterone replacement therapy on prostate tissue in men with late-onset hypogonadism: a randomized controlled trial. *JAMA* 2006; **296:** 2351–61.
6. Kaufman J. A rational approach to androgen therapy for hypogonadal men with prostate cancer. *Int J Impot Res* 2006; **18:** 26–31.

Effects on the cardiovascular system. A cerebrovascular accident has been reported in a young man after the overzealous self-administration of testosterone enantate intramuscularly for hypogonadism.[1] It was noted that thromboembolic complications are not generally recognised as adverse effects of androgen therapy although there is some experimental evidence that testosterone stimulates thrombus formation. A systematic review[2] found evidence concerning cardiovascular events in studies of testosterone given to men with low or normal testosterone concentrations to be of poor quality, but some data to suggest that alterations in plasma lipid concentrations and blood pressure were not significant.

1. Nagelberg SB, *et al*. Cerebrovascular accident associated with testosterone therapy in a 21-year-old hypogonadal man. *N Engl J Med* 1986; **314:** 649–50.
2. Haddad RM, *et al*. Testosterone and cardiovascular risk in men: a systematic review and meta-analysis of randomized placebo-controlled trials. *Mayo Clin Proc* 2007; **82:** 29–39.

Effects on the liver. Hepatotoxicity, including elevations in liver enzymes, hepatic cholestasis and jaundice, and rarely peliosis hepatis and hepatic tumours, has occurred with androgens and anabolic steroids, particularly the 17α-alkylated derivatives. Prolonged treatment and high doses may be significant contributory factors. Tumours have included hepatocellular carcinomas, benign adenomas, and less commonly angiosarcomas and cholangiocarcinomas. Tumours and peliosis may regress on stopping therapy, but they can also progress to liver failure and death. Some reviews of the hepatic effects of androgens and anabolic steroids are cited below.[1-5] There has been a specific report of benign hepatic adenoma in a patient treated with testosterone enantate for 11 years,[6] and of hepatocellular carcinoma in a patient given testosterone enantate and methyltestosterone.[7] Further specific references may be found under individual drug monographs.

1. Bagheri SA, Boyer JL. Peliosis hepatis associated with androgenic-anabolic steroid therapy. *Ann Intern Med* 1974; **81:** 610–18.
2. Ishak KG, Zimmerman HJ. Hepatotoxic effects of the anabolic/androgenic steroids. *Semin Liver Dis* 1987; **7:** 230–6.
3. Søe KL, *et al*. Liver pathology associated with the use of anabolic-androgenic steroids. *Liver* 1992; **12:** 73–9.
4. Touraine RL, *et al*. Hepatic tumours during androgen therapy in Fanconi anaemia. *Eur J Pediatr* 1993; **152:** 691–3.
5. Velazquez I, Alter BP. Androgens and liver tumors: Fanconi's anemia and non-Fanconi's conditions. *Am J Hematol* 2004; **77:** 257–67.
6. Carrasco D, *et al*. Hepatic adenomata and androgen treatment. *Ann Intern Med* 1984; **100:** 316.
7. Johnson FL. *et al.* Association of androgenic-anabolic steroid therapy with development of hepatocellular carcinoma. *Lancet* 1972; **ii:** 1273–6.