

For central **precocious puberty** the usual dose is the equivalent of nafarelin 800 micrograms intranasally (400 micrograms in each nostril) twice daily. If adequate suppression is not achieved at this dose it may be increased to 600 micrograms three times daily in alternate nostrils (1800 micrograms daily).

Regimens for **oocyte collection for IVF** use gonadorelin analogues for pituitary desensitisation before ovulation induction with gonadotrophins; the equivalent of 400 micrograms of nafarelin is given intranasally twice daily, beginning either in the early follicular phase (day 2) or midluteal phase (day 21) of the menstrual cycle. Therapy should be continued until down-regulation is achieved; if this does not occur within 12 weeks therapy should be withdrawn. Once down-regulation occurs gonadotrophin treatment is added to nafarelin therapy until an appropriate stage of follicular development, when both are withdrawn and chorionic gonadotrophin is given to induce ovulation.

Nafarelin has also been given in other sex hormone-related conditions.

Benign prostatic hyperplasia. For a discussion of the management of benign prostatic hyperplasia, including mention of the use of gonadorelin analogues and the view that they are unsatisfactory for indefinite therapy, see p.2178.

Prostate size decreased by a mean of 24.2% in 9 men treated for benign prostatic hyperplasia for 6 months with nafarelin acetate 400 micrograms daily subcutaneously.¹ Six months after the end of treatment, prostate size approached that of pretreatment values.

1. Peters CA, Walsh PC. The effect of nafarelin acetate, a luteinizing-hormone-releasing hormone agonist, on benign prostatic hyperplasia. *N Engl J Med* 1987; **317**: 599–604.

Endometriosis. Gonadorelin analogues are effective in the management of endometriosis (p.2091), but the need for long-term therapy to prevent recurrence limits their value because of the risk of osteoporosis; 'add-back' therapy (hormone replacement) can be used to prevent this.

References to the use of nafarelin.

- Henzl MR, et al. Administration of nasal nafarelin as compared with oral danazol for endometriosis: a multicenter double-blind comparative clinical trial. *N Engl J Med* 1988; **318**: 485–9.
- Burry KA. Nafarelin in the management of endometriosis: quality of life assessment. *Am J Obstet Gynecol* 1992; **166**: 735–9.
- Hornstein MD, et al. Retreatment with nafarelin for recurrent endometriosis symptoms: efficacy, safety, and bone mineral density. *Fertil Steril* 1997; **67**: 1013–18.
- Adamson GD, et al. Therapeutic efficacy and bone mineral density response during and following a three-month re-treatment of endometriosis with nafarelin (Synarel). *Am J Obstet Gynecol* 1997; **177**: 1413–18.
- Agarwal SK, et al. Nafarelin vs. leuprolide acetate depot for endometriosis: changes in bone mineral density and vasomotor symptoms. *J Reprod Med* 1997; **42**: 413–23.
- Zhao SZ, et al. Impact of nafarelin and leuprolide for endometriosis on quality of life and subjective clinical measures. *J Reprod Med* 1999; **44**: 1000–1006.
- Bergqvist A, et al. A comparative study of the acceptability and effect of goserelin and nafarelin on endometriosis. *Gynecol Endocrinol* 2000; **14**: 425–32.

Fibroids. Gonadorelin analogues have been tried as an adjunct or alternative to surgery in the treatment of uterine fibroids (see p.2107), although there has been some concern that this might complicate the diagnosis of malignancy.

References to the use of nafarelin.

- Minaguchi H, et al. Clinical use of nafarelin in the treatment of leiomyomas: a review of the literature. *J Reprod Med* 2000; **45**: 481–9.

Infertility. Gonadorelin analogues are used in the treatment of infertility (p.2080). As well as being used directly they are employed in regimens to induce superovulation to enable ova collection and IVF. A meta-analysis¹ found that the outcome of IVF treatment using nafarelin was equivalent to that using other gonadorelin analogues, but that nafarelin was associated with a shorter time needed for ovarian stimulation and a reduced gonadotrophin requirement.

- Wong JM, et al. Efficacy of nafarelin in assisted reproductive technology: a meta-analysis. *Hum Reprod Update* 2001; **7**: 92–101.

Porphyria. Nafarelin nasal spray was used to prevent menstrual exacerbations of acute intermittent porphyria (p.1448) in 2 sisters.¹

- McNulty SJ, Hardy KJ. Two patients with acute intermittent porphyria treated with nafarelin to prevent menstrual exacerbations. *J R Soc Med* 2000; **93**: 429–30.

Precocious puberty. Nafarelin preserved adult height potential in girls with idiopathic precocious puberty (p.2081) having a poor initial height prognosis.¹ However, reviewers have noted

that results from earlier studies into other features of precocious puberty have been equivocal.²

- Kreiter M, et al. Preserving adult height potential in girls with idiopathic true precocious puberty. *J Pediatr* 1990; **117**: 364–70.
- Chris P, Goa KL. Nafarelin: a review of its pharmacodynamic and pharmacokinetic properties, and clinical potential in sex hormone-related conditions. *Drugs* 1990; **39**: 523–51.

Preparations

Proprietary Preparations (details are given in Part 3)

Arg.: Synarel; **Austral.:** Synarel; **Braz.:** Synarel; **Canad.:** Synarel; **Cz.:** Synarel; **Denm.:** Synarel; **Fin.:** Synarel; **Fr.:** Synarel; **Ger.:** Synarel; **Hong Kong:** Synarel; **Hung.:** Synarel; **India:** Nasarel; **Irl.:** Synarel; **Israel:** Synarel; **Mex.:** Synarel; **Neth.:** Synarel; **Norw.:** Synarel; **NZ:** Synarel; **Pol.:** Synarel; **S.Afr.:** Synarel; **Spain:** Synarel; **Swed.:** Synarel; **Switz.:** Synarel; **Turk.:** Synarel; **UK:** Synarel; **USA:** Synarel.

Nandrolone (BAN, rINN) ⊗

Estrenolona; Hidroxiestrenona; Nandrolon; Nandrolona; Nandroloni; Nandrolonum; Norandrostrenolona; 19-Nortestosterone; Nortestriionato. 17β-Hydroxyestr-4-en-3-one; 3-Oxoestr-4-en-17β-yl.

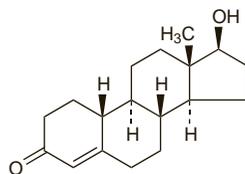
Нандролон

C₁₈H₂₆O₂ = 274.4.

CAS — 434-22-0.

ATC — A14AB01; S01XA11.

ATC Vet — QA14AB01; Q501XA11.



Nandrolone Cyclohexylpropionate (BANM, rINNM) ⊗

Ciclohexilpropionato de nandrolona; Nandrolone Cyclohexanopropionato; Nandrolone, Cyclohexylpropionate de; Nandroloni Cyclohexylpropionas; Nortestosterone Cyclohexylpropionate. 3-Oxoestr-4-en-17β-yl 3-cyclohexylpropionate; 17β-Hydroxyestr-4-en-3-one cyclohexylpropionate.

Нандролона Циклогексилпропионат

C₂₇H₄₀O₃ = 412.6.

CAS — 912-57-2.

ATC — A14AB01; S01XA11.

ATC Vet — QA14AB01; Q501XA11.

Nandrolone Decanoate (BANM, USAN, rINNM) ⊗

Decanoato de nandrolona; Nandrolon-dekanoat; Nandrolone, decanoate de; Nandroloni decanoas; Nandrolonu dekanonian; Nortestosterone Decanoate; Nortestosterone Decylate. 3-Oxoestr-4-en-17β-yl decanoate; 17β-Hydroxyestr-4-en-3-one decanoate.

Нандролона Декаоат

C₂₈H₄₄O₃ = 428.6.

CAS — 360-70-3.

ATC — A14AB01; S01XA11.

ATC Vet — QA14AB01; Q501XA11.

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

Ph. Eur. 6.2 (Nandrolone Decanoate). A white or almost white, crystalline powder. M.p. 34° to 38°. Practically insoluble in water; very soluble in alcohol and in dichloromethane. Store under nitrogen at 2° to 8°. Protect from light.

USP 31 (Nandrolone Decanoate). A white to creamy-white fine crystalline powder, odourless or may have a slight odour. Practically insoluble in water; soluble in alcohol, in acetone, in chloroform, and in vegetable oils. Store at 2° to 8° in airtight containers. Protect from light.

Nandrolone Laurate (BANM, rINNM) ⊗

Dodecanoato de nandrolona; Laurato de nandrolona; Nandrolone Dodecanoate; Nandrolone, Laurate de; Nandroloni Lauras; Nortestosterone Laurate. 3-Oxoestr-4-en-17β-yl dodecanoate; 17β-Hydroxyestr-4-en-3-one dodecanoate.

Нандролона Лаурат

C₃₀H₄₈O₃ = 456.7.

CAS — 26490-31-3.

ATC — A14AB01; S01XA11.

ATC Vet — QA14AB01; Q501XA11.

Pharmacopoeias. In *BP(Vet)*.

BP(Vet) 2008 (Nandrolone Laurate). A white to creamy-white crystalline powder. Practically insoluble in water; freely soluble in alcohol, in chloroform, in ether, in fixed oils, and in esters of fatty acids. Store at 2° to 8°. Protect from light.

Nandrolone Phenylpropionate (BANM, rINNM) ⊗

Fenilpropionato de nandrolona; Nandrolone Hydrocinamatate; Nandrolone Phenpropionate; Nandrolone, Phénylpropionate de; Nandroloni Phénylpropionas; Nandrolonu fenilpropionian; 19-Norandrostrenolone Phénylpropionate; Nortestosterone Phénylpropionate; NSC-23162. 3-Oxoestr-4-en-17β-yl 3-phenylpropionate; 17β-Hydroxyestr-4-en-3-one 3-phenylpropionate.

Нандролона Фенилпропионат

C₂₇H₃₄O₂ = 406.6.

CAS — 62-90-8.

ATC — A14AB01; S01XA11.

ATC Vet — QA14AB01; Q501XA11.

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

Iron Brew.

Pharmacopoeias. In *Br.*, *Chin.*, *Pol.*, and *US*.

BP 2008 (Nandrolone Phenylpropionate). A white to creamy-white crystalline powder with a characteristic odour. Practically insoluble in water; soluble in alcohol. Protect from light.

USP 31 (Nandrolone Phenylpropionate). Store in airtight containers. Protect from light.

Nandrolone Sodium Sulfate (rINN) ⊗

Nandrolone Sodium Sulphate (BANM); Nandrolone, Sulfate Sodium de; Nandroloni Natrii Sulfas; Nortestosterone Sodium Sulphate; Sulfato sódico de nandrolona. 3-Oxoestr-4-en-17β-yl sodium sulphate; 17β-Hydroxyestr-4-en-3-one sodium sulphate.

Нандролона Натрия Сульфат

C₁₈H₂₅O₅SNa = 376.4.

CAS — 60672-82-4.

ATC — A14AB01; S01XA11.

ATC Vet — QA14AB01; Q501XA11.

Nandrolone Undecylate (rINN) ⊗

Nandrolone Undecanoate (BANM); Nandrolone, Undécylate de; Nandroloni Undecylas; Nortestosterone Undecanoate; Undecilato de nandrolona. 3-Oxoestr-4-en-17β-yl undecanoate; 17β-Hydroxyestr-4-en-3-one undecanoate.

Нандролона Ундецилат

C₂₈H₄₆O₃ = 442.7.

CAS — 862-89-5.

ATC — A14AB01; S01XA11.

ATC Vet — QA14AB01; Q501XA11.

Adverse Effects and Precautions

As for androgens and anabolic steroids in general (see Testosterone, p.2130).

Abuse. Nandrolone, like other anabolic compounds, has been abused by athletes and bodybuilders. However, controversy has arisen over the methods used to detect abuse, and there is some evidence that metabolites of nandrolone may be produced endogenously (see under Precautions of Testosterone, p.2131).

Effects on the liver. Intrahepatic cholestasis occurred in a patient receiving nandrolone cyclohexylpropionate.¹

- Gil VG, et al. A non-C17-alkylated steroid and long-term cholestasis. *Ann Intern Med* 1986; **104**: 135–6.

Porphyria. Nandrolone has been associated with acute attacks of porphyria and is considered unsafe in porphyric patients.

Interactions

As for androgens and anabolic steroids in general (see Testosterone, p.2131).

Uses and Administration

Nandrolone is an anabolic steroid with some androgenic properties (see Testosterone, p.2131). It is usually given as the decanoate ester in the form of oily intramuscular injections. The hexyloxyphenylpropionate, propionate, phenylpropionate, and undecylate esters have also been used.

Doses of nandrolone decanoate 25 to 100 mg once every 3 to 4 weeks have been used as an anabolic after debilitating illness, for postmenopausal osteoporosis, and for postmenopausal metastatic breast carcinoma. Doses of between 50 and 200 mg weekly have been suggested for the treatment of anaemia of chronic renal failure, and doses of 50 to 150 mg weekly for aplastic anaemia.

Nandrolone sodium sulfate has been used topically in the treatment of corneal damage.

Nandrolone cyclohexylpropionate, laurate, and phenylpropionate are used in veterinary medicine.

Cachexia. Nandrolone increased lean body-mass in patients with HIV-associated wasting¹⁻⁴ (p.858) and in one study⁵ was found to have greater effect than testosterone on body-weight and BMI but a similar effect on lean body-mass. Nandrolone has also increased lean body-mass in patients with end-stage renal failure undergoing dialysis.^{6,7} Although caution is generally advised with the use of androgenic and anabolic steroids in patients with renal impairment (see Testosterone, p.2131), a study⁸ of nandrolone given for 3 months to patients with predialysis chronic renal impairment found that lean body-mass increased without