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(54) Virsraksts: **MEZOPROGESTĪNI (PROGESTERONA RECEPTORA MODULATORI) KĀ SIEVIEŠU KONTRACEPCIJAS LĪDZEKLŪ SASTĀVDAĻAS**

(57) Kopsavilkums: Izgudrojums attiecas uz mezoprogesterīnu izmantošanu medikamenta ražošanai sieviešu kontracepcijai, uz farmaceitisku preparātu sieviešu kontracepcijai un uz sieviešu kontracepcijas metodi, nozīmējot efektīvu daudzumu mezoprogesterīna. Mezoprogesterīnu var izmantot kombinācijā ar estrogēnu. Mezoprogesterīni ir definēti kā savienojumi gan ar agonista, gan ar antagonistu aktivitāti uz progesteronu receptoru (PR) *in vivo*. Tie stabilizē PR funkciju agonista un antagonistu aktivitātes vidējā līmenī. Atbilstošos funkcionālos stāvokļus nevar sasniegt ar progesṭīnu vai antiprogesṭīnu. J867, J912, J956 un J1042 ir labākie izgudrojumā aprakstīti mezoprogesterīnu savienojumi.

IZGUDROJUMA FORMULA

5 1. Mezoprogestīnu izmantošana par sastāvdaļu medikamenta ražošanai sieviešu kontracepcijai.

10 2. Mezoprogestīnu izmantošana saskaņā ar 1. punktu bez jebkāda papildus farmaceitiski aktīva savienojuma iesaistīšanas.

15 3. Mezoprogestīna izmantošana saskaņā ar 1. vai 2. punktu regulārā, cikliskā lietošanas režīmā.

20 4. Izmantošana saskaņā ar 3. punktu, kas raksturīga ar to, ka mezoprogestīna lietošana turpinās no 1. dienas līdz maksimāli 180. dienai, pie kam 1. diena tiek skaitīta kā pirmā asiņošanas diena sievietes menstruālajā ciklā.

25 5. Izmantošana saskaņā ar 4. punktu, pie kam mezoprogestīna dienas deva ir izvēlēta tā, lai stimulētu un saglabātu amenoreju.

6. Izmantošana saskaņā ar 5. punktu, kas raksturīga ar to, ka mezoprogestīna lietošana turpinās no 1. dienas līdz vismaz 21. dienai un maksimāli līdz 25. dienai, pie kam 1. diena tiek skaitīta kā pirmā asiņošanas diena sievietes menstruālajā ciklā.

30 7. Izmantošana saskaņā ar 6. punktu, pie kam mezoprogestīna dienas deva ir izvēlēta tā, lai iegūtu atgriezenisku amenoreju.

8. Izmantošana saskaņā ar jebkuru no 1. punkta līdz 7. punktam, pie kam mezoprogestīns ir J 867, J 912, J 956, J 1042.

9. Izmantošana saskaņā ar jebkuru no 1. punkta līdz 8. punktam, kas raksturīga ar to, ka mezoprogestīna dienas deva ir no 1 līdz 25 mg.

10. Izmantošana saskaņā ar 1. punktu un no 3. punkta līdz 9. punktam, kas raksturīga ar to, ka kā papildus sastāvdaļa medikamenta ražošanai tiek izmantots estrogēns.

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11. Izmantošana saskaņā ar 10. punktu, kas raksturīga ar to, ka papildus sastāvdaļa ir etinilestradiols, estradiols, estradiola esteris vai 17β -etinilestradiol-3-sulfamāts, vai 17β -estradiol-3-sulfamāts.

10 12. Izmantošana saskaņā ar 10. vai 11. punktu, kas raksturīga ar to, ka papildus sastāvdaļas estrogēna dienas deva ir no 10 līdz 30 μg etinilestradiola vai cita estrogēna bioekvivalenta daudzums.

15 13. Izmantošana saskaņā ar jebkuru no 1. punkta līdz 12. punktam, kas raksturīga ar to, ka medikaments ir pagatavots perorālai lietošanai.

14. Izmantošana saskaņā ar jebkuru no 1. punkta līdz 12. punktam, kas raksturīga ar to, ka medikaments ir pagatavots kā intrauterīna sistēma.

20 15. Izmantošana saskaņā ar 10., 11. vai 12. punktu, kas raksturīga ar to, ka vismaz viens no abiem, mezoprogestīns vai papildus sastāvdaļa estrogēns, ir pagatavots perorālai lietošanai.

16. Izmantošana saskaņā ar 10., 11. vai 12. punktu, kas raksturīga ar to, ka vismaz viens no abiem, mezoprogestīns vai papildus sastāvdaļa estrogēns, ir pagatavots kā intrauterīna sistēma.

25 17. Izmantošana saskaņā ar 2. punktu pārtrauktā, necikliskā lietošanas režīmā.

30 18. Izmantošana saskaņā ar 17. punktu, pie kam mezoprogestīnu saturošs medikaments tiek nozīmēts pēc pieprasījuma, kad kontracepcija ir vajadzīga faktiski vienam gadījumam.

19. Izmantošana saskaņā ar 18. punktu, pie kam medikaments tiek nozīmēts periodam līdz 4 dienām.

20. Izmantošana saskaņā ar 19. punktu, pie kam vismaz pirmā lietošana periodā līdz 4 dienām notiek pirms dzimumsakariem, kuriem ir vēlama kontracepcija.

21. Izmantošana saskaņā ar 20. punktu, pie kam lietošana ir vienreizēja un pirms dzimumsakariem.

22. Farmaceutiska kompozīcija, kas satur mezoprogestīnu un estrogēnu.

23. Farmaceutiska kompozīcija saskaņā ar 22. punktu, pie kam mezoprogestīns ir izvēlēts no grupas, kurā ietilpst J 867, J 912, J 956, J 1042.

24. Farmaceutiska kompozīcija saskaņā ar 22. punktu, pie kam estrogēns ir etinilestradiols, estradiols, estradiola esteris vai 17β -etinilestradiol-3-sulfamāts, vai 17β -estradiol-3-sulfamāts.

25. Farmaceutisks preparāts sieviešu kontracepcijai, kas satur mezoprogestīna dienas dozēšanas vienības, pie kam dozēšanas vienības ir nodrošinātas līdz maksimāli 180 dienām.

26. Farmaceutisks preparāts saskaņā ar 25. punktu, pie kam sekojoši mezoprogestīnam ir nodrošināti līdz 7 placebo vai līdzekļi, lai noteiktu līdz 7 beztablešu dienām.

27. Farmaceutisks preparāts saskaņā ar 26. punktu, pie kam ir nodrošinātas 21, 22, 23, 24 vai 25 mezoprogestīna dienas dozēšanas vienības un 7, 6, 5, 4 vai 3 placebo vai līdzekļi, lai noteiktu 7, 6, 5, 4 vai 3 beztablešu dienas.

28. Farmaceitisks preparāts saskaņā 26. vai 27. punktu, pie kam papildus mezoprogestīnu saturošām dozēšanas vienībām ir nodrošinātas estrogēnu saturošas dozēšanas vienības.

5 29. Farmaceitisks preparāts saskaņā ar 28. punktu, pie kam mezoprogestīns un estrogēns ir ietverti kopējās dozēšanas vienībās.

10 30. Farmaceitisks preparāts saskaņā ar 28. punktu, pie kam mezoprogestīns un estrogēns ir ietverti atsevišķās dozēšanas vienībās.

15 31. Farmaceitisks preparāts, kas satur mezoprogestīnu un estrogēnu vai estrogēnu maisījumu saturošas dienas dozēšanas vienības, pie kam šīs dozēšanas vienības ir nodrošinātas lietošanai 21, 22, 23, 24 vai 25 dienas un pie kam sekojoši šo mezoprogestīnu/estrogēnu dozēšanas vienībām ir nodrošinātas 7, 6, 5, 4 un 3 dozēšanas vienības, kas satur tikai estrogēnu vai estrogēnu maisījumu, tā, lai kopumā būtu nodrošinātas dozēšanas vienības lietošanai 28 dienas.

20 32. Farmaceitisks preparāts saskaņā ar 31. punktu, pie kam mezoprogestīns un estrogēns ir ietverti kopējās dozēšanas vienībās.

25 33. Farmaceitisks preparāts saskaņā ar 31. punktu, pie kam mezoprogestīns un estrogēns ir ietverti atsevišķās dozēšanas vienībās.

34. Farmaceitisks preparāts saskaņā ar jebkuru no 25. punkta līdz 33. punktam, pie kam mezoprogestīns ir J 867, J 912, J 956, J 1042.

30 35. Farmaceitisks preparāts saskaņā ar jebkuru no 28. punkta līdz 34. punktam, pie kam estrogēns ir etinilestradiols, estradiols, estradiola esteris vai 17β -etinilestradiol-3-sulfamāts, vai 17β -estradiol-3-sulfamāts.

36. Farmaceitisks preparāts saskaņā ar jebkuru no 25. punkta līdz 35. punktam, pie kam dienas dozēšanas vienība satur no 1 līdz 25 mg mezoprogestīna.
- 5 37. Farmaceitisks preparāts saskaņā ar jebkuru no 28. - 33., 35. un 36. punktiem, pie kam dienas dozēšanas vienība satur no 10 līdz 30 µg etinilestradiola vai cita estrogēna bioekvivalentu daudzumu.
- 10 38. Farmaceitisks preparāts saskaņā ar jebkuru no 25. punkta līdz 37. punktam, pie kam dienas dozēšanas vienība satur amenoreju izraisošu un amenoreju uzturošu mezoprogestīna daudzumu.

Fig. 1A un 1B

Progesterona receptora (PR) modulatoru progesteronam līdzīga (augšā, Fig. 1A) un progesteronam antagonistiska (apakšā, Fig. 1B) iedarbība nenobriedušu trušu, kam iepriekš dots estrogēns, dzemdē (MakFeila (McPheil) tests)

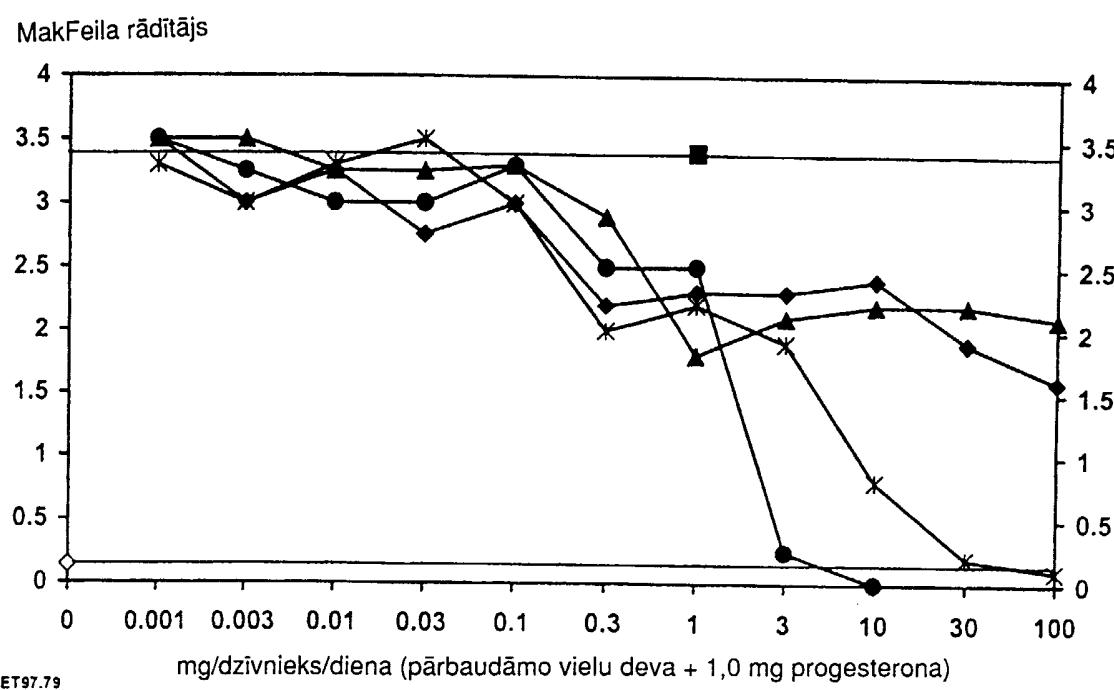
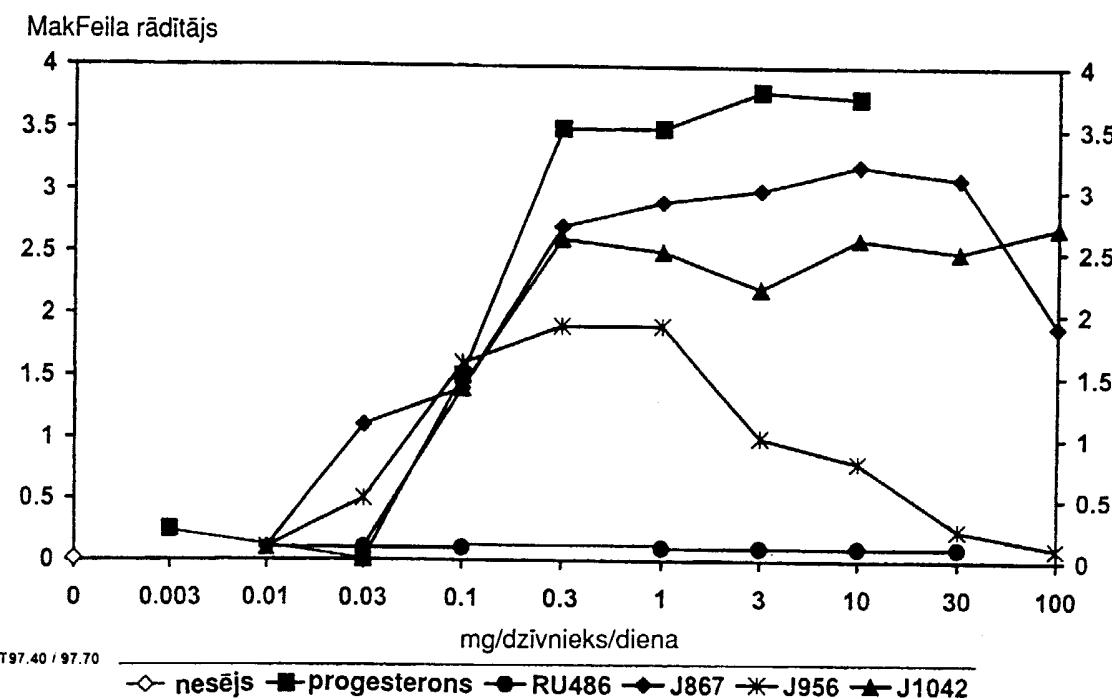


Fig. 2.

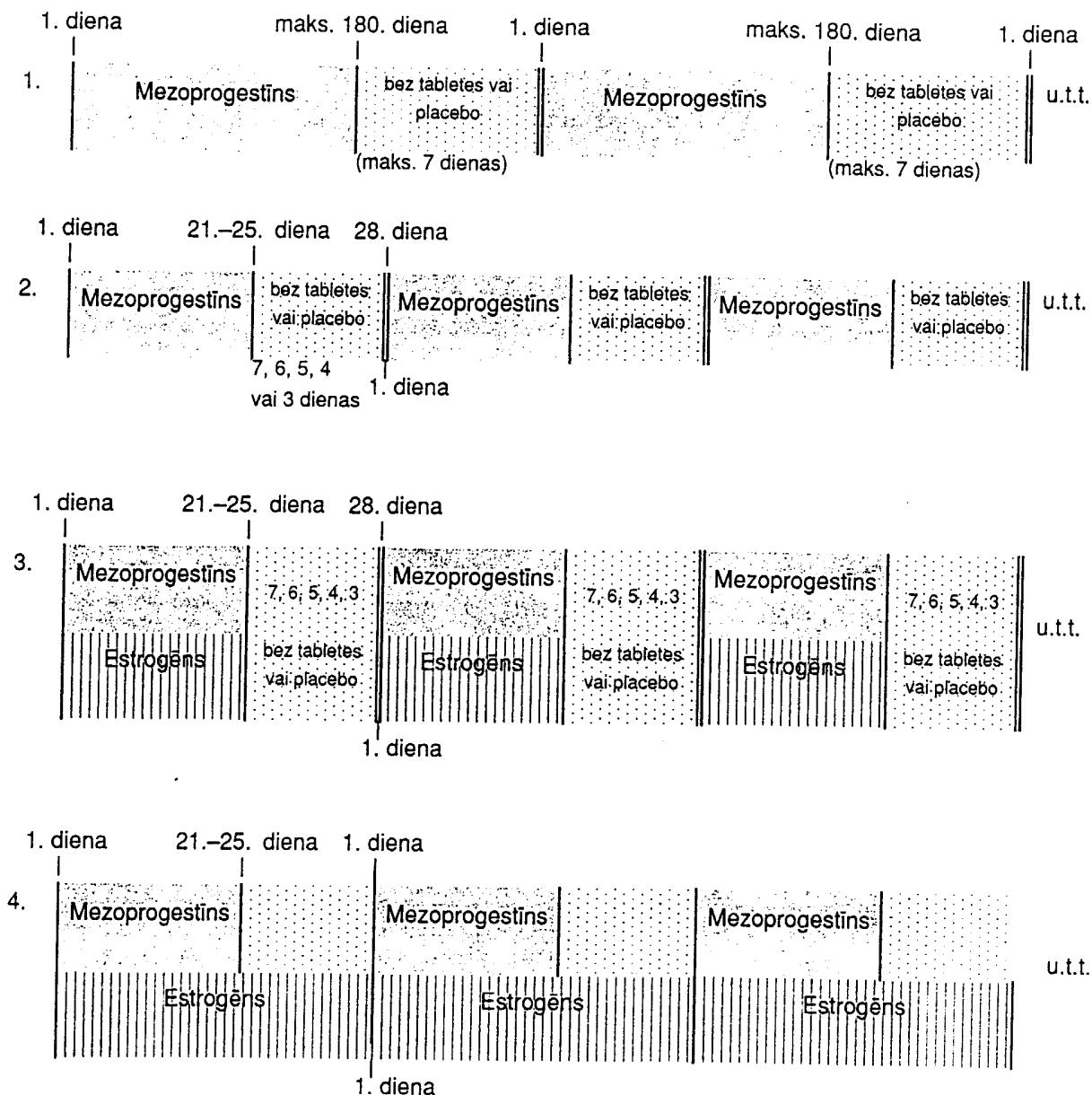
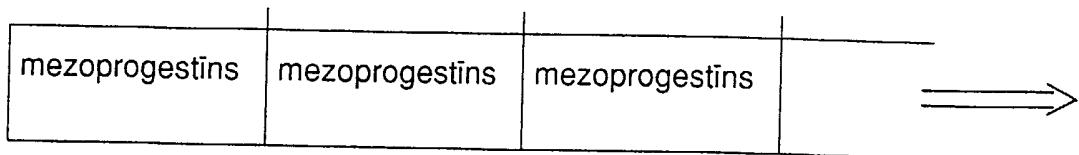


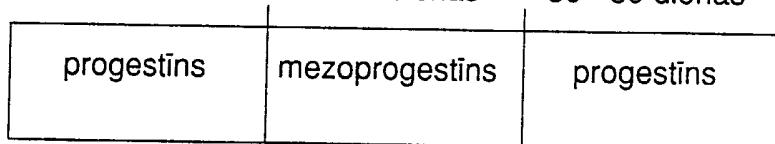
Fig. 2. (turpin.)

5. 1. diena 28. diena 56. diena 84. diena



6.

30 - 80 dienas 1 - 30 dienas 30 - 80 dienas



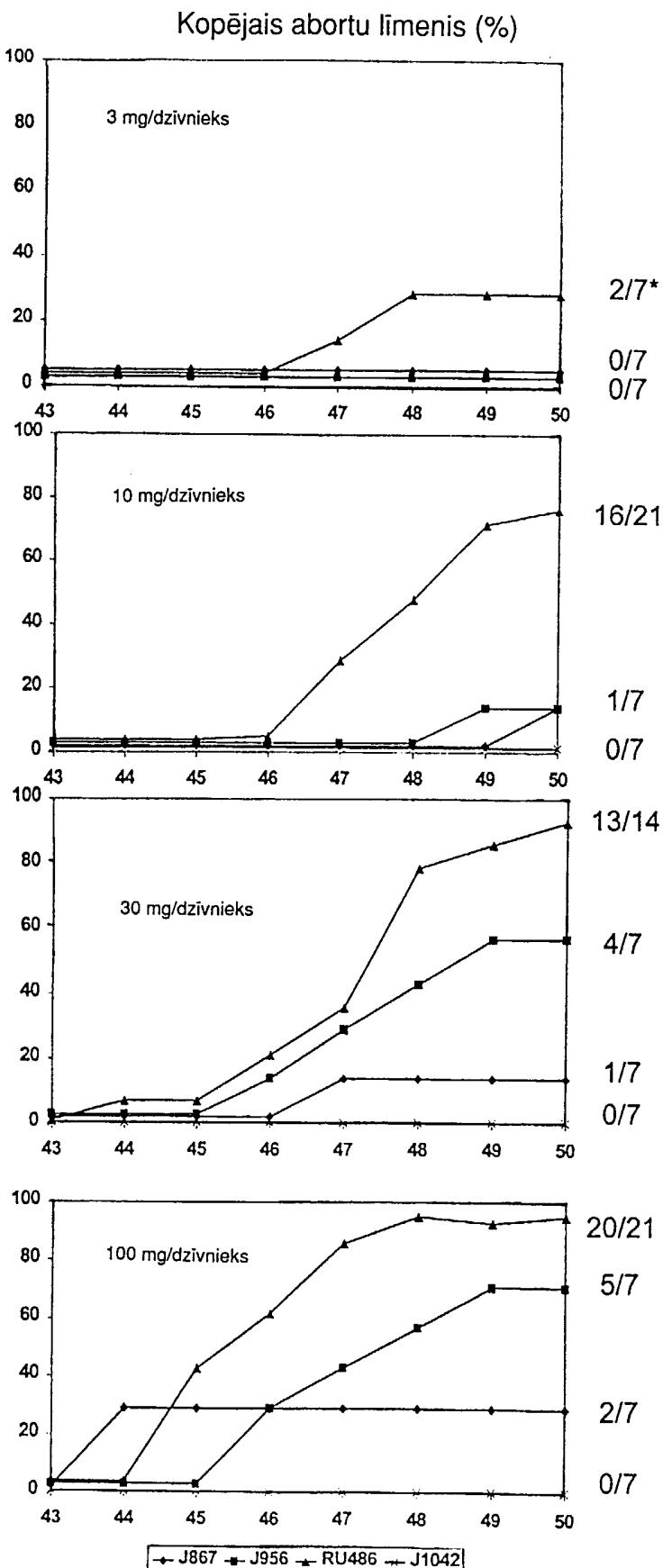


Fig. 3.

Kopējais abortu līmenis periodā līdz 50 dienai jūrascūciņām, kas apstrādātas 43. un 44. grūtniecības dienā. ar s.c. injekcijām. (#/#) = abortu līmenis

Mesoprogesterins (Progesterone Receptor Modulators) as a component of female contraceptives

The present invention relates to the field of contraception. More particularly it relates to the use of mesoprogesterins for the production of a pharmaceutical for female contraception, to a pharmaceutical preparation for female contraception and to a method of female contraception administering effective amounts of a mesoprogesterin to a female desiring contraception.

For female oral contraception different pharmaceutical preparations are available.

The most prevalent form of oral contraception is a pill that combines both an estrogen and a progestin, a so-called combined oral contraceptive preparation. Apparently, the progestin acts to block gonadotropin releases (inhibition of ovulation); the estrogen component provides endometrial control to diminish breakthrough bleeding.

Alternatively, there are contraceptive preparations that comprise progestin only. However, the progestin-only preparations (= progesterone-only pill = POP) have a more varied spectrum of side effects than do the combined preparations, especially more breakthrough bleeding. As a result, the combined preparations are the preferred oral contraceptives in use today (Sheth et al., Contraception, 25:243, (1982)).

Antiprogestins (also termed as „progesterone antagonists“ or „antigestagens“) are a class of compounds that block the progesterone receptor. For example, RU 486 (mifepristone) is a progesterone receptor antagonist. RU 486 binds to the progesterone receptor and produces a blockade of the binding of progesterone to its receptor. When administered in the luteal phase of the menstrual cycle, RU 486 induces vaginal bleeding.

The prior art has demonstrated either inhibition of the ovulatory menstrual cycle or delayed endometrial maturation. It has been demonstrated in primate models that both a single injection of the antiprogestin RU 486 (5 mg/kg i.m.) in the late follicular phase or a once weekly oral RU 486 dose of 25 mg prevented ovulation (Collins et al., J. Clin. Endocrinol. Metab. 1986, 63:1270-1276; Danforth et al., Contraception 1989, 40:195-200).

Using various study protocols which differed in regimen and dose, it has been demonstrated by several groups of investigators that RU 486 inhibits ovulation in women as well (Shoupe et al., Am. J. Obstet. Gynecol. 1987, 157:1421-1426; Liu et al., J. Clin. Endocrinol. Metab. 1987, 65:1135-1140; Luukkainen et al., Fertil. Steril. 1988, 49:961-963).

An ovulation inhibiting activity has also been demonstrated for other progesterone antagonists than RU 486 (Zelinski-Wooten, M.B., Slayden, O.D., Chwalisz, K., Hess, D.L., Brenner, R.M., Stouffer, R.L. (1998a) Chronic treatment of female cycling rhesus monkeys with low-doses of the antiprogestin ZK 137 316: Establishment of a regimen that permits normal menstrual cyclicity. *Hum Reprod* 13: 259-267).

Consequently, several approaches for antiovulatory strategies to achieve contraception with progesterone antagonists have been suggested.

Also contraceptive approaches in which the RU 486 acts via implantation inhibition have been described.

In the so-called „LH+2“ treatment (Swahn et al., „The luteal effect of RU 486 administration during the early luteal phase on bleeding pattern, hormonal parameters and endometrium“, *Human Reproduction* 5, 4:402-408 (1990)) 2 days after occurrence of the LH peak (LH = Luteinizing Hormone) an ovulation-inhibiting dose of RU 486 is administered one time. The active compound is thus administered only after the time of ovulation in the luteal phase of the menstrual cycle (luteal contraception).

A contraception method using competitive progesterone antagonists is disclosed in WO 93/23020. Below their ovulation inhibiting dose and the abortive dose progesterone antagonist, preferably after oral administration, achieve contraception in females, by inhibition of implantation. The method does not adversely affect the female's menstrual cycle and is without risk of aborting a previous implanted fertilized egg or a fetus. The application of the progesterone antagonist occurs at least once in the follicular phase of the female's menstrual cycle (i.e. before ovulation). The preferred frequency of administration is daily or it follows in regular intervals of some days, e.g. weekly or with a distance of 3 or 4 days between the single administrations of active compound.

WO 94/18982 teaches a method of inhibiting fertilization of an oocyte which comprises administering a fertilizing inhibitory amount of an antiprogestin to an ovulatory mammal. The amount is insufficient either to prevent ovulation or to interfere with the regularity of the ovarian menstrual cycle of the mammal. The preferred frequency of administration is daily.

According to one aspect of the present invention mesoprogesterins are used as a component for the production of a pharmaceutical for female contraception.

They can be used either as single pharmaceutically active principle in female contraceptives or they can be used together with an estrogen.

According to one aspect of the invention the mesoprogesterins, either alone or in combination with estrogens, are used in a regular, cyclical administration regime. This shall mean that the mesoprogesterins are administered in identical and repeating administration cycles as long as contraception is desired.

A cycle starts with the administration of a mesoprogesterin or mesoprogesterin / estrogen containing dosage unit followed daily by further dosage units thereof. Each cycle is completed by a period in which no active dosage units („pill-free“ days) or in which placebos are administered.

Alternatively in case of mesoprogesterin / estrogen administration the administration cycle can be completed by further administration of estrogen only containing dosage units.

A new application cycle starts on the first day after completion of the „pill free“ or placebo phase, respectively or after the phase in which estrogen only containing dosage units have been administered.

In all cases day 1 in the first administration cycle is the first day of bleeding in the female's menstrual cycle in which the contraceptive treatment starts.

One embodiment of the mesoprogesterin only administration provides for administering the mesoprogesterin containing dosage units up to day 180 at the maximum. Under the continuos daily treatment (1 to 25 mg mesoprogesterin/day) a reversible amenorrhoea is induced and maintained. The contraceptive effect is due to endometrial effects (endometrial suppression) of the mesoprogesterin. Consequently the endometrium is not prepared for implantation of a fertilized egg. To achieve the contraceptive effect it is sufficient to administer the mesoprogesterin in dosages to prevent nidation. The dose of the mesoprogesterin can also be ovulation inhibiting but this is not essential to achieve the contraceptive effect and to induce and maintain amenorrhoea.

Preferably the mesoprogesterin only administration takes place for 3 months at the maximum (this allows to check the contraceptive reliability of the method).

Compared to other contraceptive regimes which use progestins only the above described administration regime leads to a better bleeding behavior. Compared to the minipill

(progesterone only pill) and to subcutaneous implants loaded with a progestin (Norplant) less breakthrough bleedings are observed.

With the methods using a progesterone antagonist as disclosed in WO 93/23020 and WO 94/18982 the normal cycle was maintained.

A next embodiment of the mesoprogesterin only administration takes place continuously for more than 3 months, for example, 1-3 years. Since a mesoprogesterin suppresses endometrial growth and prevents endometrial vessel fragility it can be used chronically. In addition a condition of chronic but reversible amenorrhea is achieved.

A next embodiment of the mesoprogesterin only administration provides for administering the mesoprogesterin containing dosage units up to day 21, 22, 23, 24 or 25 either followed by a period of 7, 6, 5, 4 or 3 days during which no active compound is administered or followed by the administration of 7, 6, 5, 4 or 3 placebo pills so as to complete a 28 day long cycle. On the next day the next cycle starts with the administration of a mesoprogesterin containing dosage unit, etc.

In this last mentioned administration regime the mesoprogesterin acts like a progestin by blocking the ovulation and inducing amenorrhoea and triggering withdrawal bleeding. Breakthrough bleedings are not induced. The withdrawal bleeding is due to endometrial transformation induced by the mesoprogesterin. Consequently, in this embodiment the mesoprogesterin has to be administered, at least in the luteal phase of the female's menstrual cycle, in an ovulation-inhibiting dose.

A variant of the last mentioned embodiment (not yet claimed) is to administer dosage units containing mesoprogesterin in an ovulation inhibiting dose exclusively during the luteal phase of the female's menstrual cycle (no administration in the follicular phase).

Amenorrhoea inducing doses of mesoprogesterins can be determined by methods known to a person skilled in the art for example in clinical studies.

Generally the daily dose of the mesoprogesterin will be in the range of 1 to 25 mg.

If an estrogen is administered in addition to the mesoprogesterin both active components are administered from day 1 (see above) to day 21, 22, 23, 24 or 25 of the female's menstrual cycle either followed by a period of 7, 6, 5, 4 or 3 days during which no active compound is administered or followed by the administration of 7, 6, 5, 4 or 3 only estrogen containing dosage units or followed by the administration of 7, 6, 5, 4 or 3 placebo pills, respectively so

as to complete a 28 day long administration cycle. On the next day the next cycle starts with the administration of a mesoprogesterin/estrogen containing dosage unit, etc.

The estrogen is used in a daily amount of 10 to 30 µg ethinyl estradiol or a bioequivalent amount thereof.

Mesoprogesterins can be used sequentially with a progestin. In this contraceptive regimen the mesoprogesterin component prevents breakthrough bleeding which is usually associated with chronic progestin treatment. The progestin component at a dose used in so called "mini pill regimen" is administered for a period of 30-180 days, whereas the mesoprogesterin component is administered for a period of 1-30 days.

During mesoprogesterin treatment menstrual bleeding may or may not occur. As a result of sequential progestin/mesoprogesterin treatment the number of unscheduled bleeding is, however, markedly reduced.

The regular, cyclical administration regimes of a mesoprogesterin, optionally in combination with an estrogen, are illustrated in detail in Figure 2.

The use of a mesoprogesterin in a discontinuous, non-cyclical administration regime is the use as a so-called demand pill which has to be administered only around the time point of sexual intercourse for which contraception is desired. Preferably the administration is before sexual intercourse („medicinal condom"). For details c.f. WO 93/23020.

A further aspect of the invention refers to a pharmaceutical combination product (composition) containing a mesoprogesterin together with an estrogen.

A further aspect of the invention refers to a pharmaceutical combination product (composition) containing a mesoprogesterin together with a progestin.

Yet another aspect of the invention deals with pharmaceutical preparations for female contraception comprising daily dosage units of a mesoprogesterin.

All the aspects of the pharmaceutical preparation according to the invention are apparent from claims 25 to 38.

As mesoprogesterins i.a. compounds disclosed in DE 43 32 283 and in DE 43 32 284 are suitable for the purposes of the invention.

These aforementioned compounds, for instance J 867 [4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-oxim] and J 912 [4-[17 β -Hydroxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-oxim] (both DE 43 32 283) and J 900 [4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-[O-(ethoxy)carbonyl]oxim], J 914 [4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-(O-acetyl)oxim] and J 956 [4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-[O-(ethylamino)carbonyl]oxim] (all DE 43 32 284) are described as compounds having strong antiprogestagenic and compared to RU 486 having markedly reduced antiglucocorticoid activity. Moreover these compounds are mentioned to have (indirect) antiestrogenic properties reflected by reduced uterine weights in cyclic guinea pigs.

These effects should promise the exertion of a particularly favorable influence on pathologically modified tissues in which estrogens stimulate growth (endometriotic focuses, myomas, etc.).

The disclosure of these applications does not pertain to the use of the new compounds for female contraception or to pharmaceutical preparations for this purpose.

Also, a progestagenic activity of the compounds which is advantageous for the herein claimed indication contraception is not mentioned in these applications at all.

Further, the mentioned applications are silent about any active dose to be used to treat any of the therein mentioned conditions.

According to the invention mesoprogesterins are defined as compounds possessing both agonistic and antagonistic activities at the progesterone receptor (PR) in vivo. As progestins and antiprogestins, mesoprogesterins show high binding affinity to PR. However, mesoprogesterins exhibit different pharmacodynamic properties compared to either progestins or antiprogestins. The presence of progesterone agonistic activity in mesoprogesterins measured in commonly used biological tests in vivo represents the key property of this novel class of PRMs. This activity remains, however, below that of progesterone in the plateau of the dose response curve. Mesoprogesterins fail to maintain pregnancy in ovariectomized pregnant rodents as mice and rats.

In the classical bioassay, the McPhail test, assessing progestagenic and antiprogestagenic effects in rabbits (Selye H., Textbook of Endocrinology, 1947, pp. 345-346), progesterone produces a maximum McPhail score of 4 (by definition). Treatment with a mesoprogesterin in the absence of progesterone leads, however, to a McPhail score which is higher than that

under any dose of RU 486, i.e. above 0.5 - 1.0, preferentially 2.0 - 3.0, but to distinctly lower score than 4 at the plateau of the dose response curve at the clinically relevant doses for the claimed indications (i.e. 0.01 mg – 30 mg/rabbit).

The capacity of mesoprogesterins to antagonize progesterone function is also tested in the McPhail test using a progesterone dose which induces a McPhail score ranging between 3 and 4. A mesoprogesterin inhibits the effect of progesterone to a significant degree, but the maximum inhibition is below that which is inducible with RU 486 or other pure antiprogestins (e.g. onapristone).

The mesoprogesterins stabilize, therefore, the function of PR at an intermediate activity level providing the rationale for the novel clinical applications in gynecological therapy.

Corresponding functional states cannot be achieved with progestins or antiprogestins.

Pharmacological results demonstrating the utility of the mesoprogesterins in the claimed indications

The PR antagonistic and agonistic properties of mesoprogesterins were assessed in estrogen-primed rabbits in the McPhail test according to Selye (Textbook of Endocrinology, 1947, pp. 345-346).

A) Assessment of PR agonistic properties of mesoprogesterins in rabbits (Figure 1 A)

The progestagenic activity of J867, J956, J1042 [4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-[O-(ethylthio)carbonyl]oxim (German Patent Application 198 09 845.6)] and RU 486 (dose range: 0.003-100 mg/rabbit) was evaluated in estradiol-primed juvenile rabbits after 4 days of subcutaneous (s.c.) treatment in the absence of progesterone). The progestagenic effect of the mesoprogesterins was observed at doses equal to or higher than 0.03 mg/rabbit. Progesterone induced endometrial transformation at doses equal to or higher than 0.1 mg reaching a maximum effect at 1 mg/rabbit (approximately McPhail score 4). Neither mesoprogesterin tested (J1042, J867, J956) reached the maximum effect of progesterone. J956 showed a biphasic response in this test with a maximum effect of McPhail score 1.5 at 0.3-1 mg/rabbit.

B) Assessment of PR antagonistic properties of mesoprogesterins in rabbits (Figure 1B)

Similarly, the antiprogestagenic activity of J867, J956, J1042 and RU 486 (dose range: 0.001-100 mg/rabbit) was evaluated in estradiol-primed juvenile rabbits after 4 days of subcutaneous (s.c.) treatment in the presence of progesterone (1 mg/rabbit s.c.). The first antiprogestagenic effect of the mesoprogesterins and RU 486 was observed with a dose of 0.3-1 mg mg/rabbit (McPhail index 0 = no transformation; 4 = complete transformation). The antiprogestagenic activity of mesoprogesterins at higher clinically relevant doses doses (i.e. 3-30 mg/rabbit) was lower than that of RU 486.

In the guinea pig model which allows a good prediction of the effects in humans with respect to the abortifacient activity (Elger W, Beier S., Chwalisz K, Fähnrich M, Hasan SH, Henderson D, Neef G, Rohde R (1986): Studies on the mechanism of action of progesterone antagonists. *J Steroid Biochem* 25: 835-845) the mesoprogesterins J 867, J 912, J 956, J 1042 lead up to 100 mg/kg/day to a maximal abortion rate of 20%.

C) Evaluation of abortifacient effects

Physiological background:

The guinea pig is considered as relevant model of human gestation and parturition (Elger W, Fähnrich M, Beier S, Quing SS, Chwalisz K (1987). Endometrial and myometrial effects of progesterone antagonists in pregnant guinea pigs. *Am J Obstet Gynecol* 157: 1065-1074; Elger W, Neef G, Beier S, Fähnrich M, Gründel M, Heermann J, Malmendier A, Laurent D, Puri CP, Singh MM, Hasan SH, Becker H (1992). Evaluation of antifertility activities of antigestagens in animal model. In: Puri CP and Van Look PFA (eds), *Current Concepts in Fertility Regulation and Reproduction*. Wiley Eastern Limited, New Delhi, pp. 303-328; Elger W, Faehnrich M, Beier S, Qing SS, Chwalisz K (1986). Mechanism of action of progesterone antagonists in pregnant guinea pigs. *Contraception* 6: 47-62; Elger W, Chwalisz K, Faehnrich M, Hasan SH, Laurent D, Beier S, Ottow E, Neef G, Garfield RE (1990). Studies on labor-conditioning and labor-inducing effects of antiprogestones in animal model. In: Garfield RE (eds), Norwell, pp. 153-175.) The mechanism of abortion of antiprogestins in this species is the initiation of labor and finally the expulsion of the conceptus. Abortifacient effects in the rat during very early pregnancy reflect inhibitory effects on nidation rather than initiation of uterine contractions. Studies in the rat model lead to "overestimation" of the potential of antiprogestins to terminate pregnancy in humans. Conversely, in the guinea pig model, irrespective of the antiprogestin doses, there were high rates of ongoing pregnancies

similar to the situation in humans (Elger et al., *Current Concepts in Fertility Regulation and Reproduction cited above*). Furthermore, in both humans and guinea pigs, there is a strong synergism between antiprogestins and prostaglandins with respect the induction of labor (see the articles cited above and Elger W, Beier S (1983). Prostaglandine und Antigestagene für den Schwangerschaftsabbruch (Prostaglandins and antigestagens for pregnancy termination). German Patent DE 3337450 12; Van Look P, Bygdeman M (1989). Antiprogestational steroids: a new dimension in human fertility regulation. *Oxford reviews of reproductive medicine* 11: 2-60).

Assessment of labor inducing activity: Figure 3.

Pregnant guinea pigs were treated on days 43 and 44 of pregnancy and observed until day 50 of gestation. For the effects of various treatments see table 1 and figure 3. It is typical for this model that expulsions occur with a delay of several days after treatment. It can be seen that Mesoprogesterins have a much reduced abortifacient activity compared to RU486. The following ranking of abortifacient activity was found: RU486>J956>J867, J912>J1042. The differences with respect to abortifacient activity seem qualitative ones. It is not possible to overcome the low abortifacient activity of a Mesoprogesterin by the use of a higher dose.

Table 1: Studies of relative binding activity (RBA) and ED₅₀ of abortifacient activity in pregnant rats and guinea pigs.

compound	RBA (%) #		abortifacient activity	
	PR ¹	GR ²	rat ³	guinea pig ⁴
<u>RU 486</u>	506	685	0.98*	3.8
<u>Onapristone</u>	22	39	1.71*	ca 3
J867	302	78	0.65*	>100
J956	345	154	0.64*	20
J912	162	16	0.36	> 100
J1042	164	42	> 10	>> 100

by Kaufmann; ¹progesterone = 100%, ²dexamethasone = 100%

³treatment days 5 – 7 of pregnancy, autopsy day 9, ⁴treatment day 43 – 44 of pregnancy, autopsy day 50, *SAS, probit procedure.

The mesoprogesterin is preferably selected for this invention from the group of the compounds J867, J912, J956, J1042.

Further preferred mesoprogesterins are

4-[17 β -Hydroxy-17 α -(ethoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-oxim;

4-[17 β -Methoxy-17 α -(ethoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-oxim;

4-[17 β -Hydroxy-17 α -(chlormethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-oxim;

4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-(O-methyl)oxim (all DE 43 32 283)

and

4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-[O-(phenylamino)carbonyl]oxim;

4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-[propionyl]oxim;

4-[17 β -Methoxy-17 α -(methoxymethyl)-3-oxoestra-4,9-dien-11 β -yl]benzaldehyd-(1E)-[benzoyl]oxim (all DE 43 32 284).

The amount per daily dosage is in the range of 1 to 25 mg of mesoprogesterin.

As estrogens, all estrogenically active compounds are suitable for the purposes of this invention.

- Estrogens that can be used within the scope of this invention are, for example, ethinylestradiol, 17 β -estradiol as well as its esters such as estradiol-3-benzoate, estradiol-17-valerate, -cypionate, -undecylate, -enanthate and/or other estradiol esters (US-PS 2,611,773, US-PS 2,990,414, US-PS 2,054,271, US-PS 2,225,419 and US-PS 2,156,599) and conjugated estrogens.
- Estradiol-, ethinylestradiol- and estrone-3-sulfamates, for example estrone-N,N-dimethylsulfamate, estrone-N,N-diethylsulfamate, ethinylestradiol-3-N,N-dimethylsulfamate, ethinylestradiol-3-N,N-diethylsulfamate, ethinylestradiol-3-N,N-tetramethylenesulfamate, estrone sulfamate, estradiol-3-sulfamate, estradiol-3-N,N-dimethylsulfamate, estradiol-3-N,N-diethylsulfamate, ethinylestradiol-3-sulfamate, which all represent prodrugs for the corresponding 3-hydroxy compounds (W. Elger et al., in J.

Steroid Biochem. Molec. Biol., Vol. 55, No. 3/4, 395-403, 1995; DE 44 29 398 A1 and DE 44 29 397 A1), can also be used in the pharmaceutical agent according to the invention.

As progestins useful in the invention, all compounds are suitable that are suitable for use in oral contraceptives because of their progestin activity. An exemplary list of such compounds is found in B. Runnebaum et al., "Female Contraception: Update and Trends," Springer-Verlag, Berlin, 1988, pages 64-90, 109-121, 122-128 and 129-140. Preferred progestins within the scope of this invention are gestodene, progesterone, levonorgestrel, cyproterone acetate, chlormadinone acetate, drospirenone (dihydrospiorenone), norethisterone, norethisterone acetate, norgestimate, desogestrel or 3-ketodesogestrel. In the embodiment containing a progestin according to this invention, the progestin is present in a dosage form that is suitable for oral administration, namely as a tablet, coated tablet, capsule or pill. In this case, the formulation of the progestin is done in a way analogous to preparing progestins for hormonal contraception with use of the adjuvants that are commonly used for this purpose. A daily dosage unit of the progestin contains the latter at a dose of 0.6-6.0 mg of levonorgestrel, 2-20 mg of cyproterone acetate, 0.3-3.0 mg of gestodene or 0.2-2.0 mg of desogestrel or an amount of another progestin that is equivalent in action to these dosages.

Determining equivalent-action dose amounts of various progestins is done according to known methods; further details are found in, for example, the two articles "Probleme der Dosisfindung: Sexualhormone [Problems of Dose-Finding: Sex Hormones]"; F. Neumann et al. in "Arzneimittelforschung [Drug Research]" 27, 2a, 296-318 (1977) as well as "Aktuelle Entwicklungen in der hormonalen Kontrazeption [Current Developments in Hormonal Contraception]"; H. Kuhl in "Gynäkologe [Gynecologists]" 25: 201-240 (1992).

According to all embodiments, mesoprogestin can be present in dosage units that are intended for daily oral administration.

The estrogen can also be present in daily oral dosage units.

If the dosage units of the mesoprogestin are provided for administration over a period of 7 days, these dosage units can advantageously be present in the form of a dosage unit that can be administered once a week.

In such a dosage unit that is to be administered once a week, the mesoprogesterin should preferably be prepared in a formulation that results in a delayed release of the active ingredient.

A delayed release of the mesoprogesterin can be achieved, for example, by formulating the dosage unit that is to be administered orally as a composite tablet or by providing the dosage unit that is to be administered orally with a timed-disintegration coating, as is readily known to one skilled in the art.

By derivatization, for example by esterification of a free hydroxy group in an effective precursor, the mesoprogesterin that is used for the production of the pharmaceutical agent according to the invention can also have a longer half-life than this precursor. As a result, a longer-lasting action is also achieved.

For the purposes of this invention, the formulation of the mesoprogesterin and optionally the estrogen is done in a completely conventional manner, as is already known for the formulation of these compounds for their individual use as described for J867 in DE 43 32 283 and for estrogen therapy, for example Cyclo-Progynova.

In particular, reference is also made to the information that is contained in the mentioned prior art documents.

In addition to oral administration of the estrogen and the mesoprogesterin, it is equally possible to administer one or both of the components transdermally, for example with a skin patch, which is best known for the administration of estrogen (Climara Patch).

In addition, administration can be done using an intrauterine release system (c.f. Mirena), but this variant is not preferred within the scope of this invention.

The administration of one or both components as a depot formulation is also possible.

Finally, all above-mentioned types of administration can be combined. For example, the estrogen can be administered transdermally with a skin patch, and the progesterone antagonist can be administered daily orally or one or more times as a depot formulation.

The estrogen is contained per daily dosage unit according to the invention in an amount of 10 to 30 µg of ethinylestradiol or a bioequivalent amount of another estrogen.

In the pharmaceutical agent according to the invention, the mesoprogesterin is contained in each dosage unit preferably in an amount such that, when used over the intended length of time, it is sufficient for amenorrhea to occur.

In an preferred embodiment of the pharmaceutical agent according to the invention, the mesoprogesterin is contained in each daily dosage unit in an amount that is equivalent to 1 to 25 mg of J 867.

The bioequivalent doses of a mesoprogesterin can be assessed in the McPhail test.

The packaging that contains the pharmaceutical preparation according to the invention is prepared in such a way that, in addition to the one or two components mesoprogesterin and estrogen in the respectively intended form of administration (orally in the form of pills, coated tablets, etc. in a blister pack, as may be appropriate for mesoprogesterin and/or estrogen, or the estrogen as a skin patch and the mesoprogesterin in the form of pills, coated tablets, etc. in a blister or in a capsule as a depot that is to be administered once), said packaging also contains instructions for the use of the pharmaceutical agent (package insert).

Claims:

1. Use of mesoprogesterins as a component for the production of a pharmaceutical for female contraception.
2. Use of mesoprogesterins according to claim 1 without any further pharmaceutically active compound being involved.
3. Use according to 1 or 2 of a mesoprogesterin in a regular, cyclical administration regimen.
4. Use according to claim 3 characterized in that the administration of the mesoprogesterin ensues from d1 up to maximally d180, d1 being counted as the first day of bleeding of the female's menstrual cycle.
5. Use according to claim 4 whereby the daily amount of the mesoprogesterin is selected so as to induce and maintain amenorrhoea.
6. Use according to claim 5 characterized in that the administration of the mesoprogesterin ensues from d1 up to at least d21 and maximally d25, d1 being counted as the first day of bleeding of the female's menstrual cycle.
7. Use according to claim 6 whereby the daily amount is selected so as to achieve reversible amenorrhoea.
8. Use according to anyone of the preceding claims 1 to 7, wherein the mesoprogesterin is J 867, J 912, J 956, J 1042.
9. Use according to anyone of the preceding claims 1 to 8 characterized in that the daily dose of the mesoprogesterin is 1 to 25 mg.
10. Use according to claims 1 and 3 to 9 characterized in that as an additional component for production of the pharmaceutical an estrogen is used.
11. Use according to claim 10 characterized in that the additional component is ethinylestradiol, estradiol, estradiol ester or a 3-sulfamat of 17 β -ethinylestradiol or 17 β -estradiol.
12. Use according to claim 10 or 11 characterized in that the daily dose of the additional component estrogen is 10 to 30 μ g ethinylestradiol or a bioequivalent amount of another estrogen.

13. Use according to anyone of preceding claims 1 to 12 characterized in that the pharmaceutical is formulated for oral administration.
14. Use according to anyone of preceding claims 1 to 12 characterized that the pharmaceutical is formulated as an intrauterine system.
15. Use according to claim 10, 11 or 12 characterized in that at least one of both, mesoprogesterin and additional component estrogen, is formulated for oral administration.
16. Use according to claim 10, 11 or 12 characterized in that at least one of both, mesoprogesterin and additional component estrogen, is formulated as an intrauterine system.
17. Use according to claim 2 in a discontinuous, non-cyclical administration regime.
18. Use according to claim 17 wherein the mesoprogesterin containing pharmaceutical is administered on demand when contraception is desired actually for one occasion.
19. Use according to claim 18 wherein the administration is for a period of up to 4 days.
20. Use according to claim 19 wherein at least the first administration within the period of up to 4 days is before sexual intercourse for which contraception is desired.
21. Use according to claim 20 wherein the administration is once and before sexual intercourse.
22. Pharmaceutical composition containing a mesoprogesterin and a estrogen.
23. Pharmaceutical composition according to claim 22 wherein the mesoprogesterin is selected from the group of the compounds J 867, J 912, J 956, J 1042.
24. Pharmaceutical composition according to claim 22 wherein the estrogen is ethinylestradiol, estradiol, estradiol ester or a 3-sulfamat of 17 β -ethinylestradiol or 17 β -estradiol.
25. Pharmaceutical preparation for female contraception comprising daily dosage units of a mesoprogesterin wherein dosage units for up to maximally 180 days are provided.
26. Pharmaceutical preparation according to claim 25 wherein consecutively to the mesoprogesterin up to 7 placebos or measures to indicate up to 7 pill free days are provided.

27. Pharmaceutical preparation according to claim 26 wherein 21, 22, 23, 24 or 25 daily dosage units of the mesoprogesterin and 7, 6, 5, 4 or 3 placebos or measures to indicate 7, 6, 5, 4 or 3 pill free days are provided.
28. Pharmaceutical preparation according to claims 26 or 27 wherein in addition to the mesoprogesterin containing dosage units estrogen containing dosage units are provided.
29. Pharmaceutical preparation according to claim 28 wherein the mesoprogesterin and the estrogen are contained in common dosage units.
30. Pharmaceutical preparation according to claim 28 wherein the mesoprogesterin and the estrogen are contained in separate dosage units.
31. Pharmaceutical preparation comprising daily dosage units containing a mesoprogesterin and a estrogen or a mixture of estrogens wherein these dosage units are provided for administration for 21, 22, 23, 24 or 25 days and wherein consecutively to these mesoprogesterin/estrogen dosage units 7, 6, 5, 4 or 3 dosage units containing only estrogen or a mixture of estrogens are provided so that in total dosage units for administration for 28 days are provided.
32. Pharmaceutical preparation according to claim 31 wherein the mesoprogesterin and the estrogen are contained in common dosage units.
33. Pharmaceutical preparation according to claim 31 wherein the mesoprogesterin and the estrogen are contained in separate dosage units.
34. Pharmaceutical preparation according to anyone of preceding claims 25 to 33 wherein the mesoprogesterin is J 867, J 912, J 956, J 1042.
35. Pharmaceutical preparation according to anyone of preceding claims 28 to 34 wherein the estrogen is ethinylestradiol, estradiol, estradiol ester or a 3-sulfamat of 17 β -ethinylestradiol or 17 β -estradiol.
36. Pharmaceutical preparation according to anyone of preceding claims 25 to 35 wherein the daily dosage unit contains 1 to 25 mg of mesoprogesterin.
37. Pharmaceutical preparation according to anyone of preceding claims 28 to 33, 35 and 36 wherein the daily dosage unit contains 10 to 30 μ g ethinylestradiol or a bioequivalent amount of another estrogen.

38. Pharmaceutical preparation according to anyone of preceding claims 25 to 37 wherein the daily dosage unit contains an amenorrhoea inducing and amenorrhoea maintaining amount of a mesoprogesterin.

Figures 1A and 1B

Progesterone-like (above, Fig. 1A) and progesterone antagonistic (below, Fig. 1B) effects of PR-modulators in the uterus of estrogen primed immature rabbits (McPhail test)

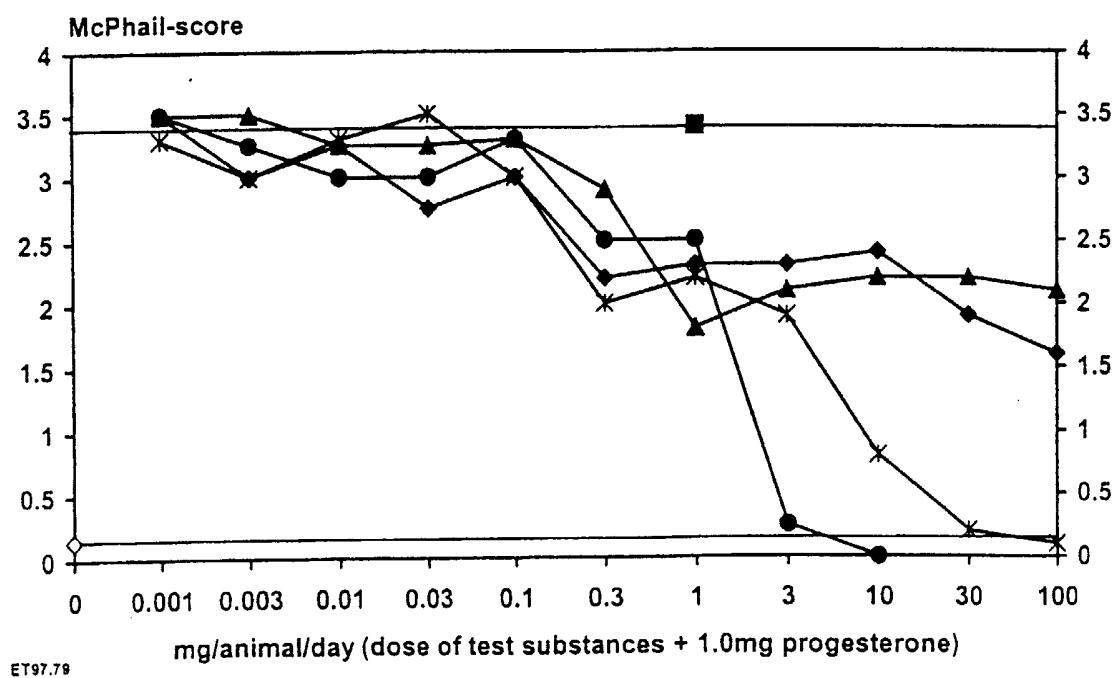
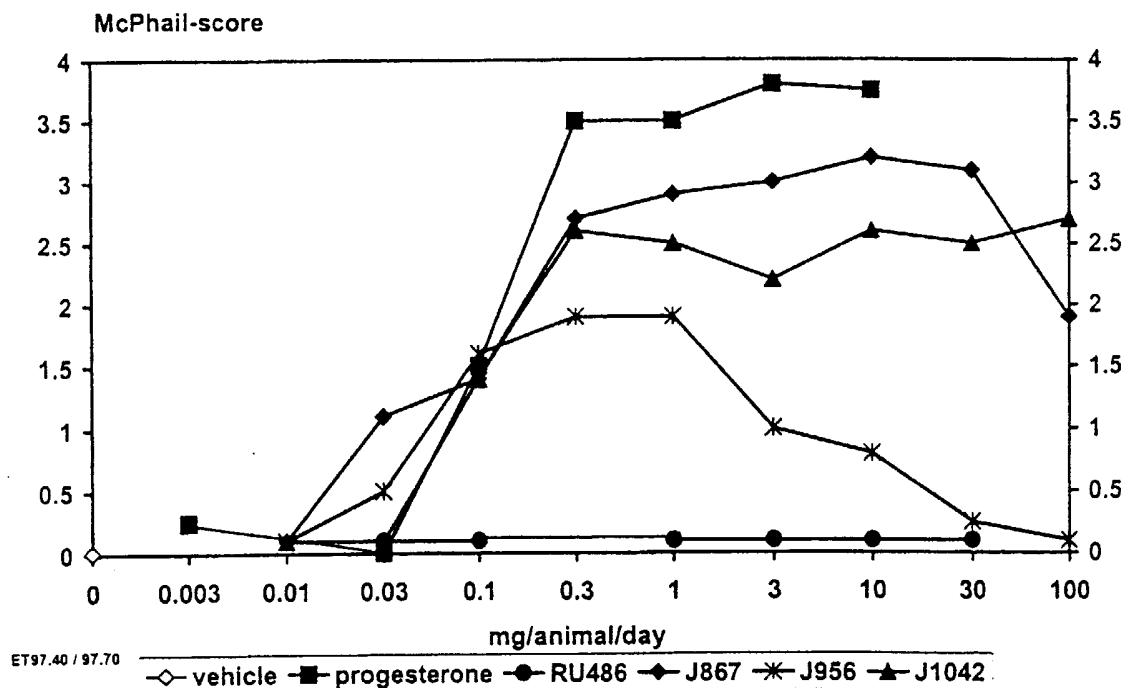
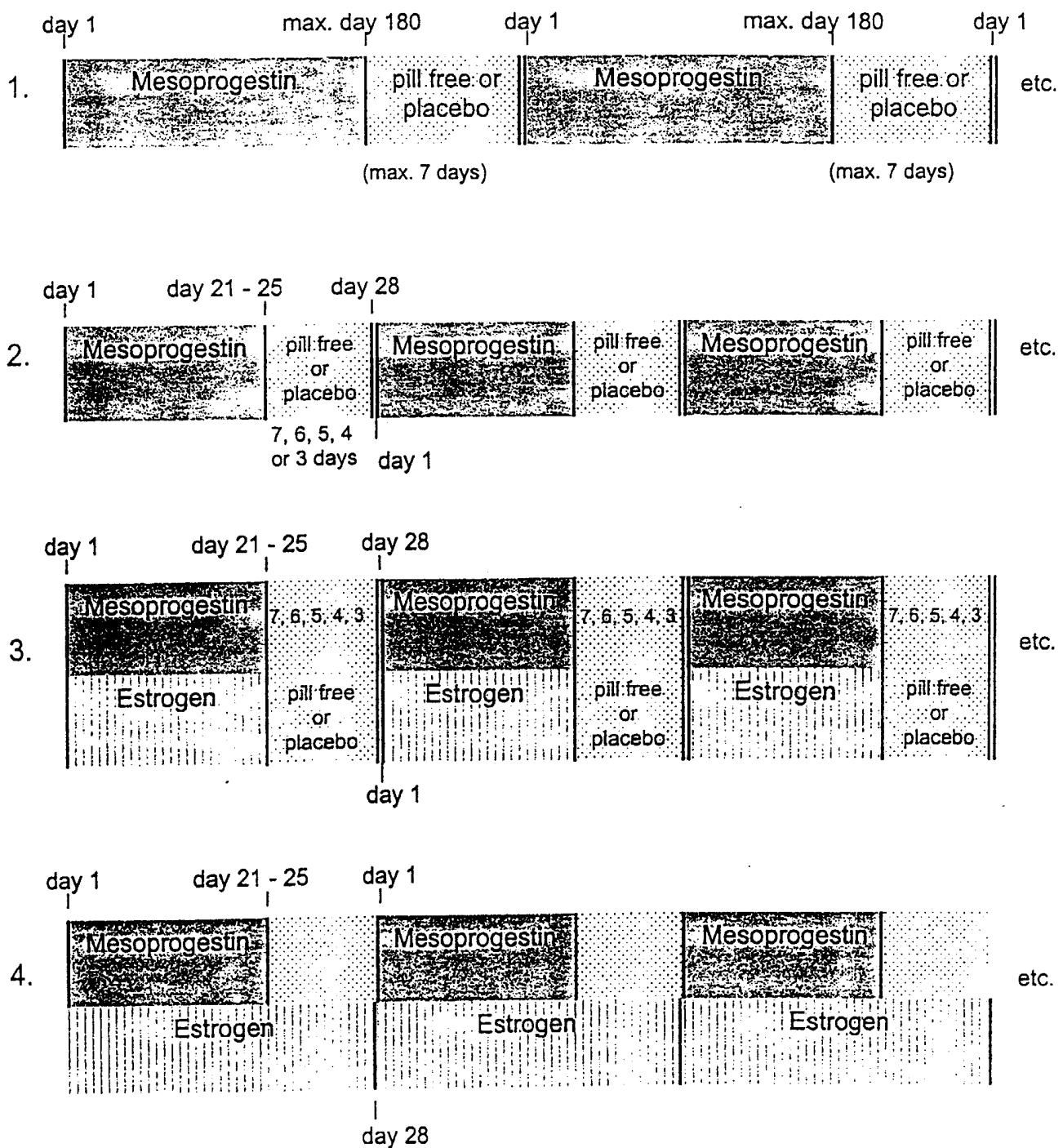


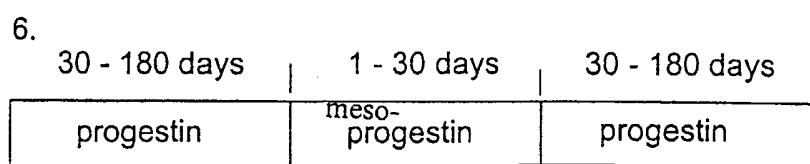
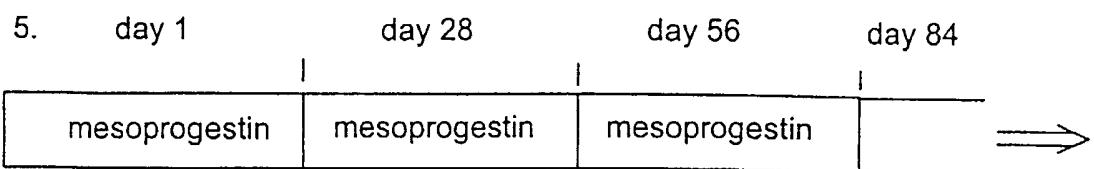
Figure 2

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Fig. 2 (con't.)



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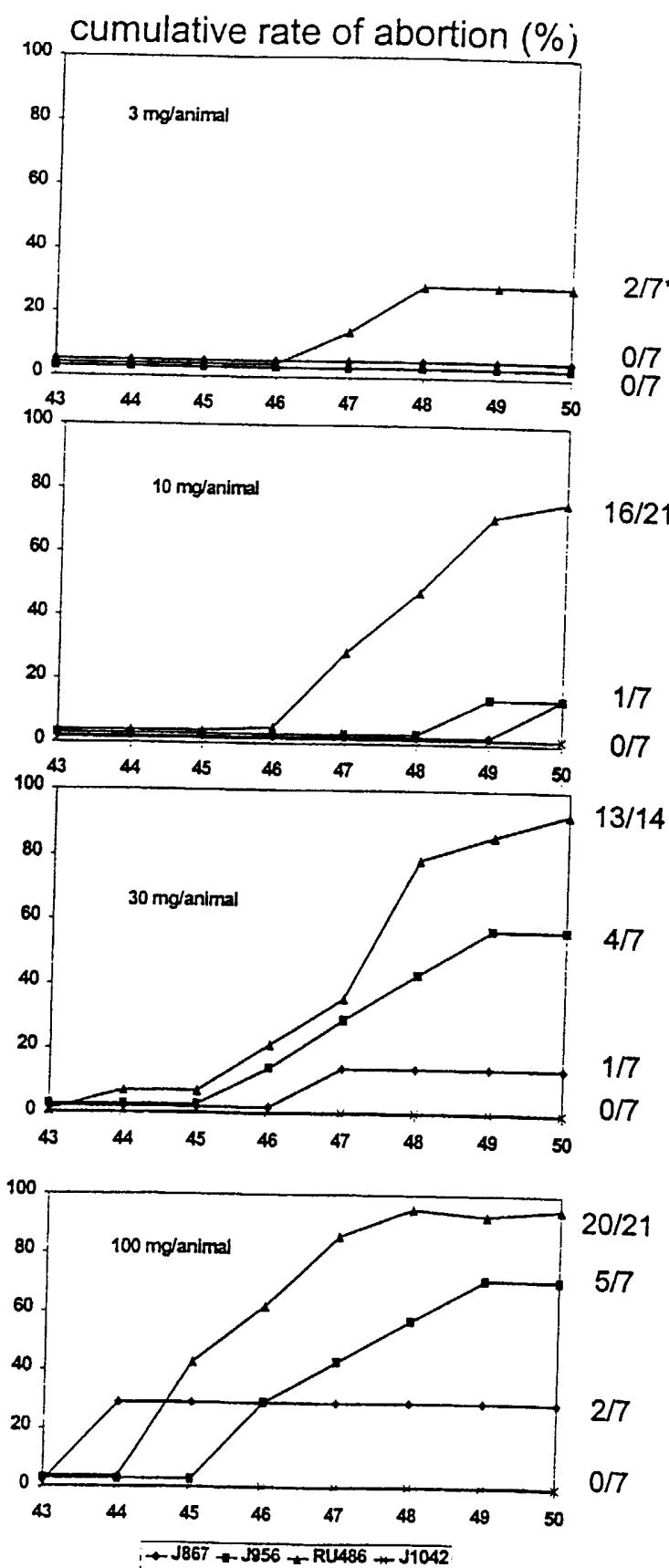


Figure 3: Cumulative rate of abortion until day 50 in guinea pigs treatment on days 43 and 44 of pregnancy by s.c. injection. (#/#) = rate of abortion

Abstract:

The present invention relates to the use of mesoprogesterins for the production of a pharmaceutical for female contraception, to a pharmaceutical preparation for female contraception and to method of female contraception administering effective amounts of a mesoprogesterin in a female desiring contraception. Optionally the mesoprogesterin can be used in combination with an estrogen. Mesoprogesterins are defined as compounds possessing both agonistic and antagonistic activities at the progesterone receptor (PR) in vivo. They stabilize the function of PR at an intermediate level of agonistic and antagonistic. Corresponding functional states cannot be achieved with progestins or antiprogestins. J867, J912, J956 and J1042 are the mesoprogesterins preferred according to the invention.