馬ノ排卵機轉ノ内分泌學的考察

鈴木善祐 星 冬四郎

(東京帝國大學農學部 家畜生理學教室)

(昭和 21 年 11 月 18 日受附)

I. 緒 言

馬ノ排卵時期ヲ人爲的ニ規制シ得ベ種付回数ノ節約及ビ人工授精ノ効果ヲ高メ馬ノ増殖ニ大イニ貢獻シ得ルトノ意圖ヲ以テ Prolan ニ依ル馬ノ人工排卵試験ヲ行ツタ MIRSKAIA 等モ同様ノ意圖ノ下ニ實驗セルコトガ Allen ノ編書⁽¹⁾ニ引用サレテキル 未發表ノタメ用量其他詳細ハ不明デアルガ Prolan 注射後 30~48 時間ニ排卵シソノ 80% ガ受胎セルコトヲ記シテキル 余等ノ成績モ亦馬ノ人工排卵ノ可能ナルコトヲ認メタルモ本來ノ目的達成ニハ未ダ不充分デアル 然シナガラ馬ノ排卵機轉ノ内分泌學的考察ニ極メテ意義深いモノデ茲ニ其ノ成績ヲ報告シ考察ヲ加ヘルコトトシタ

II. 實驗方法

供試馬トシテ朝鮮馬 3 頭ヲ用ヒ直腸検査法ニ依リ毎回油土ヲ以テ卵巢もでるヲ作り排卵ニ迄達セル卵胞ノ發育狀態ヲ追跡觀察シタ 第 1 回ノ排卵ハ各馬共正常ノママ觀察シテ對照トナシ第 2 回ヨリ卵胞ガ適當ノ發育度ニ達セル時期ニほるもんヲ給與シ連日直腸検査法ニ依リ排卵ヲ確認シタ 又最終回實驗ニハ各馬共受胎試験ヲ行ヒ排出卵ノ健否ヲ吟味シタ

供試ほるもんトシテハ余等ガ妊婦尿ヨリ製出セルぶろらんノ高精製度 (1mg=1000 M. U.) ノモノヲ用ヒ使用毎ニソノ所用量ヲ滅菌生理的食鹽水 5 cc ニ溶解シ頸靜脈内ニ 1 回ニ注射シタ

・ 卵胞發育度 卵胞ノ發育經過ヲ卵胞ノ大キサ及ビ觸感ノ變化ニヨリ概ネ 4 階程ニ大別シ得ルヲ以テ卵胞發育度 1°~4° トシ成績ノ檢討ヲ進メタ

〔日本獸醫學雜誌, 第 9 卷, 第 1・2 號, 昭和 22 年 4 月〕

卵胞發育度 1° (小卵胞) 直徑 2 cm 内外ニシテ卵巢表面ニ僅カニ隆起シ硬彈力性觸感ヲ有スルモノデ直腸検査ニヨリ確認シ得ル最小ノモノデアル

卵胞發育度 2° (中卵胞) 直徑 3 cm 内外ニシテ柔軟ナル彈力性觸感ヲ有スルモノ

卵胞發育度 3° (大卵胞) 直徑 4 cm 程度ニ及ビ波動性彈力ヲ有スルモノ

卵胞發育度 4° (排卵期卵胞) 直徑 5 cm 以上ニ達シ表面極度ニ緊張セル硬彈力性ヲ有シ波動性彈力ヲ缺クモノデアル 尙ホ此ノ種ノ卵胞ハ 10 回排卵例中 2 例ニ於テ觸知セルモ他ノ 8 例ニ於テハ此ノ時期ヲ觸知セズシテ排卵セルモノデ之ヨリ排卵期ニ於ケル卵胞ノ極度ニ緊張膨大化スル期間ハ極メテ短時間ノモノト思考セラレル

III. 實驗成績

TABLE Results on the Artificial Induction of Ovulation in Mares by the Prolan Treatment

Horse No.	No. of Exp.	Prolan Dose (M.U.)	Growth Degree of Follicle when Prolan injected	Interval between Injection and Ovulation (Hour)	Time of Ovulation		Results	Remarks
					Days after 1st Detection of Follicle	Days after when Follicle reaches Growth 2°		
5	500	.	.	.	5	4	•	Control
	501	50000	2°~3°	22~46	3	2	+	Mated and not conceived
	502	50000	2°~3°	22~46	4	3	+	
7	700	.	.	.	6	5	•	Control
	701	10000	2°~3°	94	8	6	—	Ovulated in author's hand during rectal palpation
	702	50000	3°	22~46	7	4	±	Mated and conceived
8	800	.	.	.	12	10	•	Control
	801	20000	2°~3°	70~94	10	8	—	Mated and conceived
	802	50000	3°	22~46	7	6	+	
	803	50000	3°	22~46	5	4	+	

N.B. Growth degree of follicle— 1°: Small follicle in about 2cm diameter (hard and elastic). 2°: Middle-sized follicle in about 3cm (soft and elastic). 3°: Large follicle in about 4cm (elastic and fluctuating). 4°: Follicle just before ovulation larger than 5cm (hard, elastic and not fluctuating).

5 號馬ノ卵胞ハ概シテ卵巢深部ニ於テ發育ヲ開始スルモノノ如ク卵胞觸知以前ヨリ發情徵候ヲ示シ卵胞觸知後ハ極メテ速カナル發育經過ヲタドツタ 5 萬單位ヲ注射セル 2 例ハ共ニ注射後 22~46 時間 (注射ハ午後 1 時, 直腸検査ハ毎日午前 11 時ニ行ツタ) ニ排卵シ卵胞發育期間モ對照ノ約 5 日ト云フ短時間ノモノニ於テ 1~2 日ノ短縮ヲ示シ陽性ト判定シ得ル

CHART

Growth Curves of the Ovulated Follicle, Shown in Table

7 號馬＝於ケル 1 萬單位注射例＝於テハ陰性デアツタ 5 萬單位注射例ハ注射後 22～46 時間＝排卵ヲ見此ノ點ヨリスルト陽性ト判定セラルルモ卵胞發育期間ハ對照＝比シ明カナル短縮ヲ認メ難ク疑陽性トシタ

8 號馬＝於テハ 2 萬單位注射例ハ陰性デアツタ 5 萬單位ヲ注射セル 2 例ハ共＝注射後 22～46 時間＝排卵シ卵胞發育期間ノ短縮モ明カ＝認メラレ陽性ト判定シ得ル

之ヲ要スル＝ぷろらん用量 1 萬單位及ビ 2 萬單位ノ 2 例ハ陰性ナルモ 5 萬單位ヲ卵胞ガ波動性彈力ヲ呈シ始ムル時期＝1 回＝靜脈内注射セルモノハ全例 (5 例) 共＝22～46 時間＝排卵シ 5 例中 4 例＝於テ卵胞發育期間ノ短縮ヲ認メ、内ニハ自然排卵ト一致セルモノノアルコトヲ考慮＝入レテモぷろらん＝ヨリ排卵ヲ誘發シ得ルコトガ知ラレル、又受胎試験＝ヨリ 3 例中 2 例＝陽性結果ヲ得排出卵ガ健全成熟卵ナルコトヲ確認シタ

尙ホ注射＝ヨル副作用ハ認メラレナカツタ

IV. 考 察

以上ノ如ク卵胞ノ相當程度發育セル時期＝於テ Prolan ＝ヨル人工排卵ノ可能性ヲ認メタノデアルガ本來ノ目的達成ノ爲ニハ卵胞成熟ノ更ニ早期＝於ケル試験吟味ガ必要デアル

然シ本實驗＝ヨリ得タ結果ヨリシテ馬ノ排卵期＝於ケルほるもん關係ヲ考察スルコトハ極メテ興味深イノデアル

(1) 排卵時ノ卵胞 馬ノ卵胞ハ排卵期＝近ヅケバ直徑 5 cm 前後＝モ達シ柔軟トナリ壁ハ波動性ヲ帶ブルコトガ報告サレテキル⁽²⁾ガ排卵時ノモノニ就テハ記載ガナイ 本實驗ノ 701 號ハ直腸検査中掌中＝於テ排卵セルモノデ卵胞ハ直徑 5 cm 以上＝モ達シ壁ハ極度＝緊張シテ全ク波動性ヲ失ヒ硬キ彈性體ノ感ヲ與ヘタ コノ極度＝緊張セル大卵胞ハ突然手＝微顫動感ヲ與ヘツツ急激＝退縮シ跡ニハ膜様觸感ヲ殘スノミトナツタ 斯ル排卵期＝於ケル卵胞ノ急激ナル變化ハ HILL 等⁽³⁾ガ家兎ノ排卵＝就テ開腹觀察セルトコロト極メテ類似シテキル

(2) Prolan 注射＝ヨル排卵誘發 卵胞ノ或程度發育セル時期＝多量ノ

Prolan ヲ靜脈内注射ニヨリ給與スレバ 22~46 時間ニ正常卵ノ排出ガ認メラレル

(3) 泌乳ノ排卵ニ及ボス影響 LAHR 等⁽⁴⁾ハ正常成熟雌白鼠ノ發情周期ガ Prolactin (催乳ほるもん) ノ注射ニヨリ抑制サレルコトヲ實驗シ“まうすニ於ケル泌乳期ノ無發情ハ Prolactin ニヨリ起ルモノデアル”トノ DRESEL ノ推論ヲ支持シテキル 又 BATES 等⁽⁵⁾ハ鳩ニ於ケル Prolactin ノ抗性腺刺激作用ヲ吟味シテ之ハ Prolactin ガ性腺刺激ほるもんニ對シテ拮抗作用ヲ有スルモノデハナク前葉ヨリ性腺刺激ほるもんノ分泌サレルノヲ抑制スルニアルコトヲ報告シテキル 之等ノ成績ヨリシテ馬ニ於テモ泌乳ノタメ多量ニ分泌サレタ Prolactin ガ性腺刺激ほるもんノ分泌ヲ抑制シ得ルコトハ容易ニ認メ得ルトコロデアル

牝馬中ニハ仔付キノ年ハ良發情ガアツテ之ニ牝ヲ配スルモ更ニ受胎セズ然ルニ翌年ハヨク受胎スルト云フモノガアル、仔付キノ年ニ卵巢ヲ直腸検査法ニヨツテ觸診スルニ卵泡ハヨク發育スルガ排卵セズニ萎縮退行スルコトガ認メラレル即チ所謂正常様發情ヲ呈シテキルノデアル 斯ル牝馬ノ下垂體前葉ノ機能ハ正常ノモノニ比シ弱ク、吸乳ノ刺激ニヨリ多量ニ分泌サレタ Prolactin ニヨリ容易ニ抑制セラレテ排卵期ニ於ケル前葉ノ性腺刺激ほるもん分泌ノ圓滑ヲ缺キ其ノ結果正常様發情ニ終レルモノト思考サレル

以上ノ考察ヨリシテ馬ノ卵泡ハ成熟スレバ何等交尾等ノ外的刺激ヲ要セズ自然ニ破裂排卵スルモノデアルガ排卵機轉ニ於ケルほるもん關係ハ家兎ニ於ケルト同一デ排卵期ニハ前葉ヨリノ性腺刺激ほるもんノ分泌ガ旺盛トナリ其ノ作用ニヨリ卵泡ノ細胞變化ト共ニ卵泡液ガ多量ニ分泌セラレ内壓極度ニ上昇シ遂ニ卵泡ノ破裂ヲ招來スルモノデアツテ若シ此ノ排卵期ニ於ケル前葉ノ機能が障碍サレルトキハ正常様發情ニ終ルトノ推論⁽⁶⁾ノ妥當デアルコトガ認メラレル

本研究ハ文部省科學研究費ニヨリナサレタモノデアル

参考文献

- (1) ALLEN, E., C. H. DANFORTH & E. A. DOISY: Sex and Internal Secretions, II Ed., Baltimore (1939).
- (2) 星修三: 本誌, 1, 349 (1939).
- (3) HILL, R. T., E. ALLEN & T. C. KRAMER: *Anat. Rec.*, **63**, 239 (1935).
- (4) LAHR, E. L. & O. RIDDLE: *Proc. Soc. Exp. Biol. & Med.*, **34**, 880 (1936).
- (5) BATES, R. W., O. RIDDLE & E. L. LAHR: *Amer. J. Physiol.*, **119**, 610 (1937).
- (6) 星冬四郎及島村虎猪: 本誌, **6**, 263 (1944).

CONSIDERATION ON THE ENDOCRINE MECHANISM OF OVULATION IN THE MARE.

YOSISUKE SUZUKI and TÔSIRO HOSI.

*(From the Institute of Veterinary Physiology, Faculty of Agriculture,
Tokyo Imperial University.)*

(Received for publication Nov. 18, 1946)

On account of the fact that the period of heat in the mare is much longer than that of other domestic animals, it is very important to estimate the correct time of ovulation in order to control the number of matings and to make the results of artificial insemination more certain. If the time of ovulation can be controlled artificially, a great advance should be expected in horse breeding.

With the aim to solve this problem, we carried out some experiments by employing 3 Korean mares. The successive stages of follicle destined to ovulate were traced by constricting clay models of the ovaries examined daily by rectal palpation. And these animals were treated with a single dose of prolan intravenously when the follicular development attained to a certain extent.

Results in 2 cases treated with 10000 M.U. and 20000 M.U. of prolan were negative. But, in the other 5 cases treated with 50000 M.U., ovulations took place between the 22nd~46th hour after the injection, and in 4 of them the shortening of the time intervals between the first detection of follicular development and the ovulation, and between the stage of 2° of follicular growth and the ovulation were ascertained. Besides, one of us chanced to palpate the follicle just in the course of ovulatory rupture. It is commonly stated that the matured follicle becomes fluctuating and then the rupture ensues this stage. We ascertained, however, from our present observation that the follicle just before ovulation attained an enormous size and became of a hard and elastic nature instead of being fluctuating, after which it suddenly lost its entire volume and became shrunk into some membranous thing. This stage was encountered in 2 cases, while in the other 8 cases the rupture occurred without this stage

---

[Japanese Journal of Veterinary Science, Vol. IX, Nos. 1 & 2, 1947]

being detected. So the duration of this stage must be very short.

These ova of the precipitated ovulation were confirmed to be normal by subsequent pregnancies.

From the above results we may expect the possibility of the practical application of the artificial induction of ovulation by the prolactin treatment. But, to attain this purpose, we must further carry out the experiments at earlier stages of follicular development.

From the results of the present experiments, we may draw the following conclusions on the hormonal relationship at the time of ovulation and on the cause of so-called "normal like estrus" in the mare.

(1) Though, in the mare, ovulation takes place without the stimulus of copulation, the hormonal mechanism of ovulation can be safely compared with that in the rabbit; follicles of the mare are developed to a certain extent by the effect of the gonadotropic hormones of the anterior lobe of the pituitary, and just before the ovulation the secretory nature and activity of this gland would be so changed and intensified as to result in a rapid completion of maturation and rupture of the follicle. This deduction is supported by the following two facts: firstly, the precipitation of ovulation is successfully done by prolactin treatment at an appropriate time; secondly, also in the mare a kind of "last spurt of the growth of the follicle" can be seen at the time just before ovulation, as in the rabbit.

(2) "Normal like estrus", one of the reproductive disorders in the mare characterized by the appearance of normal heat without ovulation, should be caused by the absence of the bursting output of the pituitary hormones, at the time of ovulation, as suggested in the previous report.

(3) It is well known that some mares conceive only every other year, viz. in the littering year they can not conceive despite appearance of normal heat, while in the next year they become fertile, in the littering year their follicles develop well to a certain extent, but they are followed by the atrophic change without ovulation as in ovaries of "normal like estrus". It has been stated that prolactin prevents the output of the gonadotropic hormones from pituitary, so we may conclude, also in the mare, a large amount of prolactin liberated by the stimulus of continuous suckling would prevent the bursting output of these hormones at the time of ovulation and thus would cause sterility.