

Studies on Cystic Ovarian Disease in Dairy Cattle

III. Relationship of Adrenocortical Function, Serum Concentrations of Sex Steroids and Serum Protein Pattern to Prognosis in Cows with Cystic Ovaries

Toshihiko NAKAO,* Hitoshi ONO, Kunitada SATO
and Masaru MIYAKE

(Department of Veterinary Obstetrics and Gynecology, Obihiro University
of Agriculture and Veterinary Medicine,
Obihiro, Hokkaido, Japan)

Received March 29, 1975

乳牛の卵胞嚢腫に関する研究

III. 卵胞嚢腫牛における副腎皮質機能、血中性ステロイド値並びに血清蛋白像と予後との関係について

中尾敏彦**・小野 齊**・佐藤邦忠**・三宅 勝**

Introduction

Cows with cystic ovaries (COD) were observed to have declined response of serum 11-hydroxycorticosteroids (11-OHCS) to ACTH injected intramuscularly, which differed among cows having different patterns of estrous behavior (MIYAZAWA 1972, NAKAO, *et al* 1975^a).

There were considerable differences in prognosis of COD following an intramuscular injection of corticosteroids among cows showing different estrous behavioral patterns (NAKAO, *et al* 1975^b). In cows showing anestrus which had higher adrenocortical response to ACTH than either cows exhibiting irregular estrus or those showing continuous estrus, prognosis was observed to be best among cows having different patterns of estrous behavior. In contrast to this, prognosis was worst in cows exhibiting irregular or regular estrus which had lower adrenocortical response to ACTH than cows having the other estrous behavior.

Thus adrenocortical function seems to be closely related with prognosis of COD and this may bring about the differences in prognosis among cows having different patterns of estrous behavior.

* Present address: Department of Veterinary Surgery and Obstetrics, College of Dairying, 582 Nishinopporo, Ebetsu-city, Hokkaido. ** 帯広畜産大学家畜臨床繁殖学教室

The present study was aimed to describe relationship of adrenocortical function, serum concentrations of sex steroids and serum protein pattern to prognosis of COD.

Materials and Methods

Data concerning with adrenocortical function, serum concentrations of sex steroids and serum protein pattern and also regarding to the prognosis of cows with COD which were previously reported (NAKAO, *et al* 1975^{a,b}) were used for this study.

Cows with COD were divided into three or four groups based on their serum concentrations of 11 OHCS and its response to ACTH, those of progesterone and estradiol, and those of total protein and γ -globulin, using the normal range within 95 % confidence limits of the mean value of control cows. Then pregnancy rate of each group was compared.

Multiple-discriminant analysis was applied to detect a possibility of separating cows with COD into recovering and non recovering groups, and also into early recovering and late recovering groups at the time of diagnosis prior to give treatment. Variables selected for the analysis were age, intervals after calving to diagnosis, serum 11-OHCS, serum 11-OHCS 30 minutes subsequent to ACTH injection, serum 11-OHCS increments following ACTH injection, serum progesterone, total serum protein, albumin, α -globulin, β -globulin, γ globulin and albumin globulin ratio.

Results

1. Relationship between adrenocortical function and the prognosis of COD.

(1) Relationship between serum concentrations of 11-OHCS and pregnancy rates.

A significant correlation ($P \leq 0.05$) was observed between 11 OHCS values and pregnancy expressed by a number, i.e. cases which conceived as one and cases which failed to conceive as two. Fig. 1 represents the serum concentrations of 11-OHCS and the interval after calving. In order to study the relationship of 11-OHCS to pregnancy, cows were divided into three groups based on the normal range within 95 % confidence limits of the mean value of serum 11-OHCS in control cows. In the first group comprising of cows having higher 11-OHCS concentrations than the upper limit of the normal range, the pregnancy rate was 83.3 %, higher than in the other two groups. Pregnancy rate in the second group comprising of cows where the serum concentrations of 11-OHCS fell within the limits of the normal range, was 76.9 %, lower than in the first group, but higher than in the third group. In the third group which comprised of cows showing lower concentrations of 11 OHCS than the lower limit of the normal range, only 61.1 % conceived. As can be seen from Fig. 1, when the cows were treated before the 90th day, most of cows having either higher or lower concentrations of 11 OHCS than the normal range, conceived. No significant correlation could be detected between serum concentrations of 11-OHCS and days after calving in cows with COD.

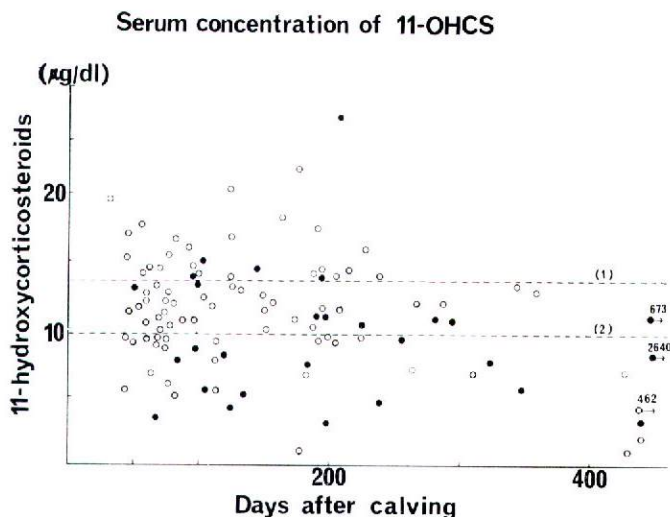


Fig. 1. Serum concentrations of 11-OHCS plotted against days after calving in cows with COD.

Note: White spots indicate cows which conceived after treatment and black spots indicate cows which failed to conceive.

(1)-(2): Normal range.

- (2) Relationship between serum 11-OHCS increments following ACTH injection and pregnancy rates.

The serum 11-OHCS increments following 50 IU ACTH injection and days after calving are shown in Fig. 2. Relationship of serum 11-OHCS increments to pregnancy rates was studied by dividing the cows into four groups. This division was based on the normal range expressed as 95 % confidence limits of the mean value of the 11-OHCS increments in control cows and also at zero increment level (Fig. 2). The highest pregnancy rate was obtained in the third group comprising of cows which had lower serum 11-OHCS increments than the lower limit of the normal range, beyond zero. Pregnancy rate in this group was 77.8 %. The pregnancy rate was 50 % in the first group comprising of cows having higher increments of serum 11-OHCS than the upper limit of the normal range, 54.5 % in the fourth group of cows showing a decrease of serum 11-OHCS in response to ACTH, 45.5 % in the second group of cows whose serum 11-OHCS increments fell within the limits of the normal range.

- (3) Correlation between serum 11-OHCS concentrations and the response to ACTH injection with regard to pregnancy rates.

The serum concentrations of 11-OHCS prior to and 30 minutes subsequent to ACTH injection are demonstrated in Fig. 3. Cows which had higher serum concentrations of 11-OHCS than the lower limit of the normal range and which also showed a high response to ACTH as detected within the limits of the normal range, excluding those which showed a negative response to ACTH, were considered to have normal adreno-

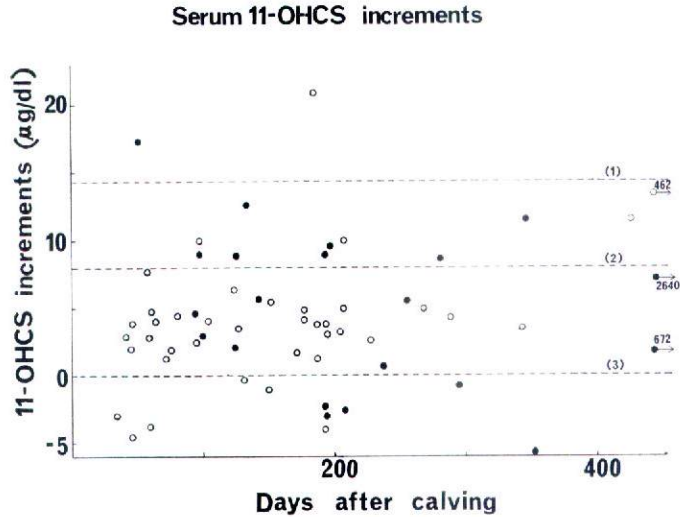


Fig. 2. Serum 11-OHCS increments following 50 IU ACTH injection plotted against days after calving in cows with COD.

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)-(2): Normal range.

(3): Zero level.

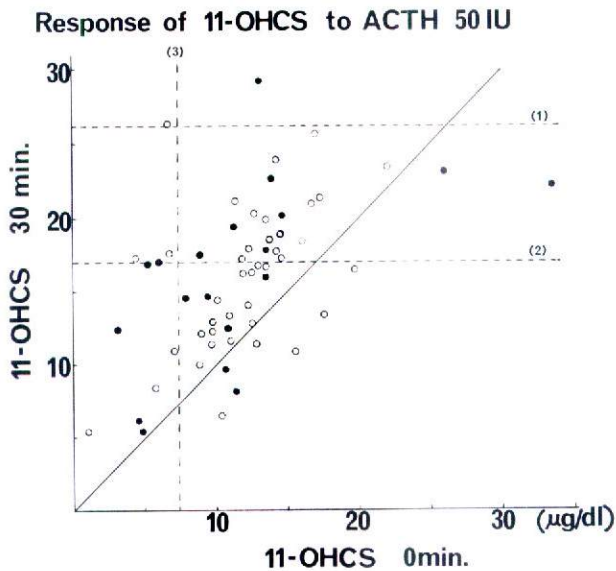


Fig. 3. Correlation between serum concentrations of 11-OHCS prior to and 30 minutes subsequent to ACTH injection in cows with COD. ($N=60$, $r=0.51$, $P \leq 0.05$).

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)-(2): Normal range.

(3): Lower limit of the normal range.

cortical function. On the other hand cows which had lower concentrations of 11-OHCS than the lower limit of the normal range were considered as having declined adrenocortical function. In cows having normal adrenocortical function pregnancy rate was considerably higher than in those having declined adrenocortical function, 78.9 % v. s. 52.6 %.

- (4) Relationship between serum 11-OHCS increments to days from treatment to conception.

A significant correlation ($r = -0.27$, $0.05 \leq P \leq 0.10$) was observed between serum 11-OHCS increments following ACTH injection and days to conception after the first treatment (Fig. 4).

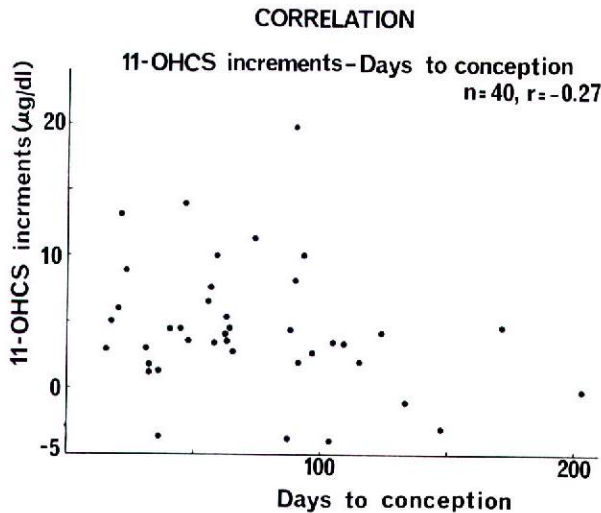


Fig. 4. Correlation between serum 11-OHCS increments 30 minutes after ACTH injection and days from treatment to conception.
(N=40, $r = -0.27$, $0.05 \leq P \leq 0.10$)

2. Relationship of serum concentrations of progesterone and estradiol 17- β to the prognosis of COD.

- (1) Relationship between serum concentrations of progesterone and pregnancy rates.

The serum concentrations of progesterone and the intervals after calving at the time of diagnosis are shown in Fig. 5. Cows were divided into three groups using the 95 % confidence limits of the normal range of progesterone concentrations at estrus. The first group comprised of cows having higher concentrations of progesterone than the upper limit of the normal range. The second group comprised of those whose serum concentrations of progesterone were within the limits of the normal range. Pregnancy rates of each group were as follows; 84.2 % in the first group, 64.5 % in the second group and 75.0 % in the third group, respectively.

- (2) Relationship between serum concentrations of progesterone and days from treatment to conception.

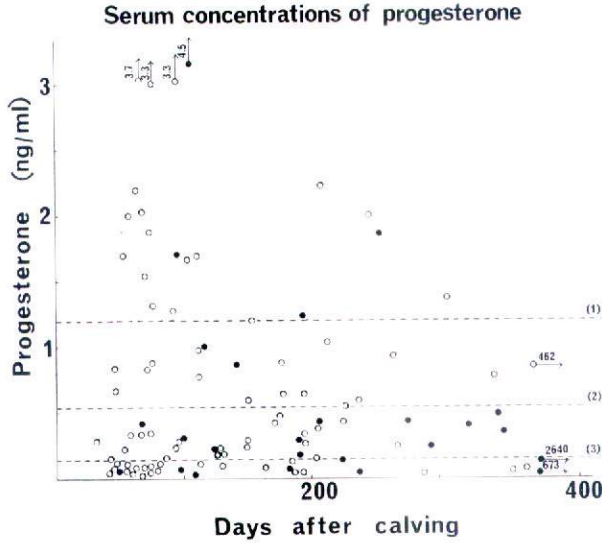


Fig. 5. Serum concentrations of progesterone plotted against days after calving at the time of diagnosis in cows with COD.

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

- (1): Lower limit of the normal range at luteal phase.
- (2)-(3): Normal range at estrus.

A significant correlation ($r=0.41$, $P \leq 0.05$) was observed between serum progesterone and days up to conception in cows showing irregular or regular estrus. (Fig. 6).

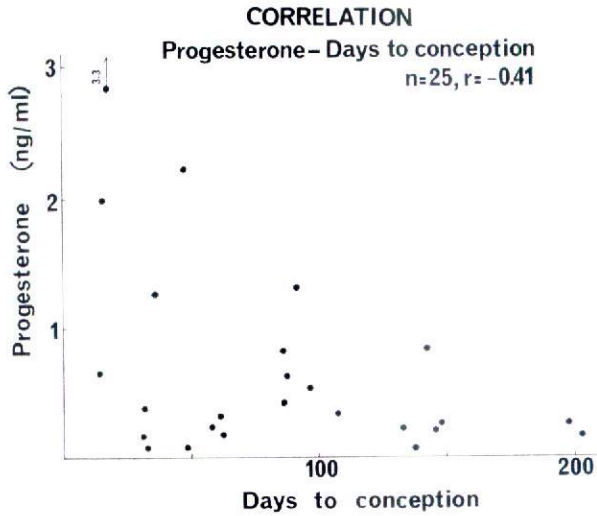


Fig. 6. Correlation between seum progesterone and days to conception in cows with COD which show irregular or regular estrus ($P \leq 0.05$).

(3) Relationship between serum concentrations of estradiol-17 β and pregnancy rates.

The serum concentrations of estradiol-17 β and the intervals after calving are presented in Fig. 7. There was no significant difference in pregnancy rates between the cows having higher concentrations of estradiol-17 β and those having lower concentrations than the limits of the normal range.

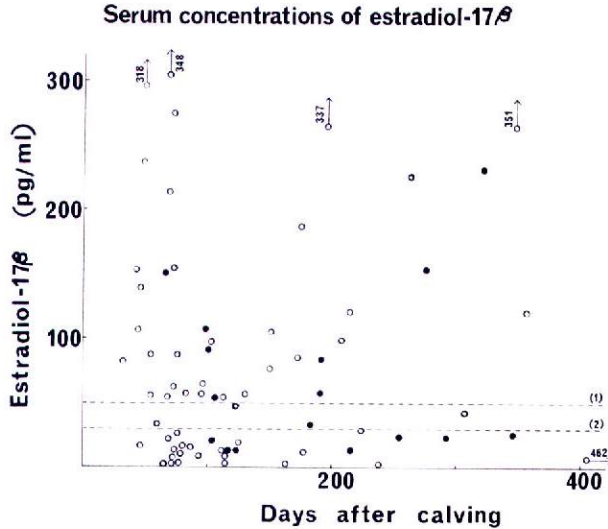


Fig. 7. Serum concentrations of estradiol-17 β plotted against days after calving at the time of diagnosis in cows with COD.

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)-(2): Normal range.

(4) Relationship between serum concentrations of estradiol-17 β and days from treatment to conception.

A significant correlation ($r = 0.35$, $0.05 \leq P \leq 0.10$) was detected between serum concentrations of estradiol-17 β and days up to conception in cows with COD showing anestrus (Fig. 8).

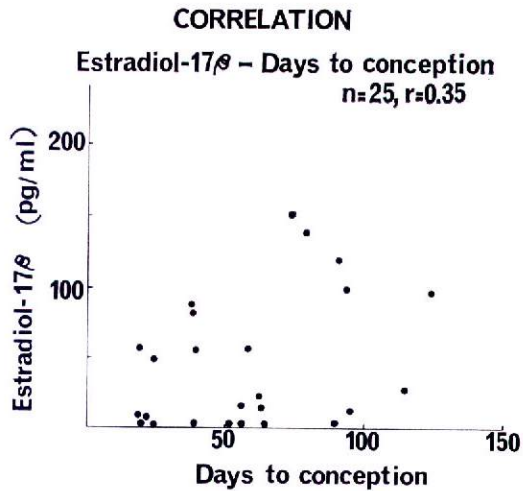


Fig. 8. Correlation between serum estradiol-17 β and days to conception in cows with COD which show anestrus ($0.05 \leq P \leq 0.10$).

3. Relationship of serum concentrations of total protein and γ -globulin to the prognosis of COD.

(1) Relationship between serum concentrations of total protein and pregnancy rates.

Total serum protein concentrations and the intervals after calving are shown in Fig. 9. Cows were divided into 4 groups according to the normal range and the upper limit of 95% confidence limits of the mean value in cows with COD. Pregnancy rate of each group was studied. In the first group comprised of cows having higher concentrations of total serum protein than the upper limit of the range in cows with COD, it was 69.4%, lower than the other three groups. The second group comprised of cows whose serum concentrations of total protein were between the upper limit of the range in cows with COD and the upper limit of the normal range. Pregnancy rate in this group was 85.7%, being the highest among the four groups. The third group comprised of cows whose serum concentrations of total protein were within the limits of the normal range. Here the pregnancy rate was 75.0%, lower than either the second or the fourth groups. Pregnancy rate in the fourth group comprising of cows which had lower concentrations of total protein than the lower limit of the normal range was 83.3%.

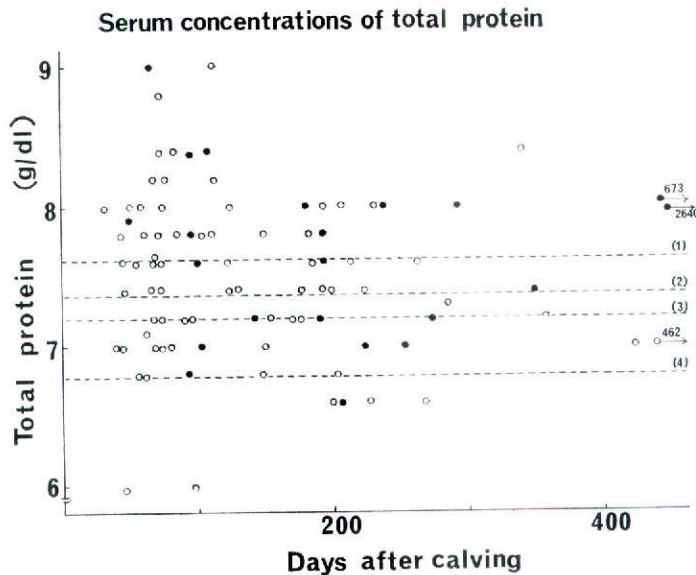


Fig. 9. Serum concentrations of total protein plotted against days after calving at the time of diagnosis in cows with COD.

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)-(2): Range in cows with COD.

(3)-(4): Normal range.

(2) Relationship between serum concentrations of γ globulin and pregnancy rates.

A significant correlation ($r=0.22$, $P \leq 0.05$) was observed between serum concen-

trations of γ -globulin and pregnancy indicated by a number, successful impregnations as one and failures as two. Gamma-globulin concentrations and the intervals after calving at the time of diagnosis are given in Fig. 10. Relationship of γ -globulin concentrations to pregnancy rates was studied by dividing the cows into 4 groups according to the normal range, and 95 % confidence limits of the mean value of γ globulin in cows with COD. Pregnancy rate was lowest (68.6 %) in the first group comprising of cows which had higher γ -globulin concentrations than the upper limit of the range in cows with COD. In cows having lower concentrations of γ -globulin than the upper limit of the range in cows with COD which also had higher concentrations than the upper limit of the normal range, pregnancy rate was 77.8 %. In the third group comprising of cows whose serum concentrations of γ -globulin were within the limits of the normal range, pregnancy rate was highest (89.5 %). Pregnancy rate in the fourth group comprising of cows which showed lower concentrations of γ -globulin than the lower limit of the normal range was 77.8 %.

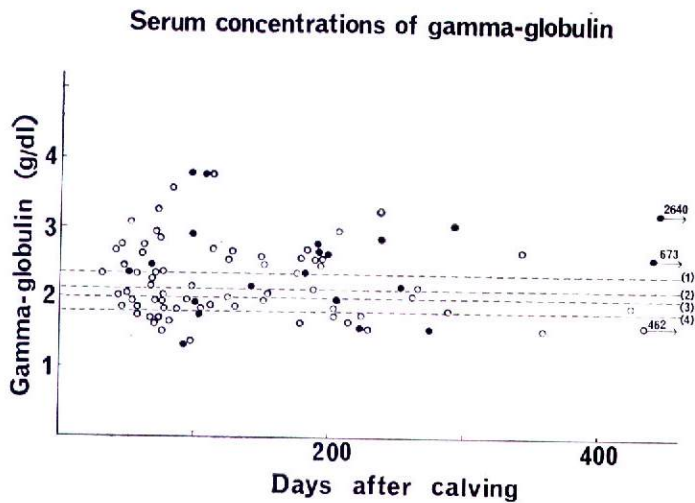


Fig. 10. Serum concentrations of γ -globulin plotted against days after calving at the time of diagnosis in cows with COD.

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

- (1)-(2): Range in cows with COD.
 (3)-(4): Normal range.

(3) Relationship of serum concentrations of total protein and γ globulin to days from treatment to conception.

There were significant correlations between total serum protein and days from treatment to conception ($r=0.57$, $P \leq 0.01$) (Fig. 11) and γ globulin and days up to conception ($r=0.52$, $P \leq 0.05$) (Fig. 12) in cows with COD showing continuous or intense estrus.

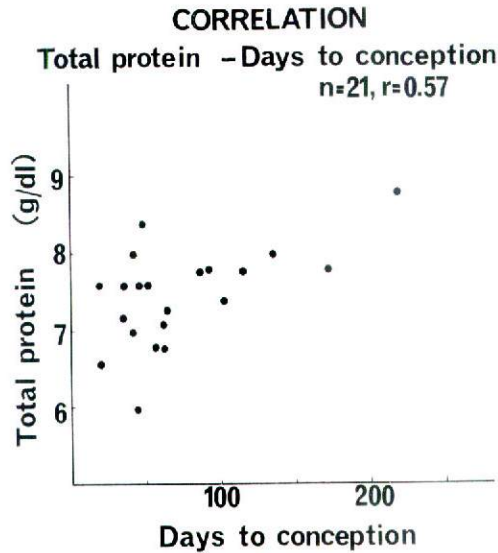


Fig. 11. Correlation between total serum protein and days to conception in cows with COD which exhibit continuous or intense estrus ($P \leq 0.01$).

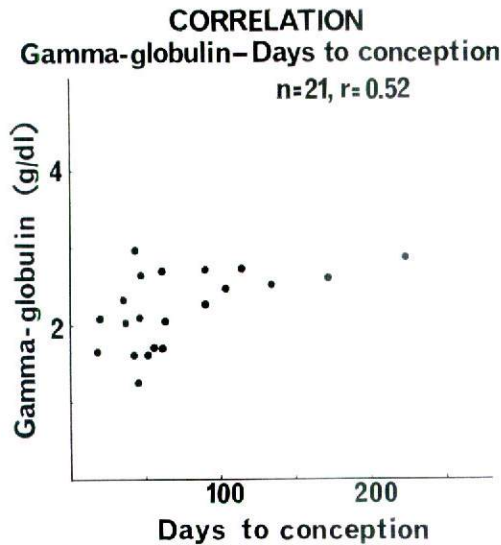


Fig. 12. Correlation between serum γ -globulin and days to conception in cows with COD which exhibit continuous or intense estrus ($P \leq 0.05$).

4. Relationship of serum 11-OHCS and its increments following ACTH injection to serum estradiol 17β and progesterone in cows with COD with regard to prognosis.

(1) Correlation between serum 11-OHCS and estradiol- 17β .

A significant correlation ($r=0.75$, $P \leq 0.01$) was detected between serum concen

trations of 11-OHCS and estradiol 17β in cows with irregular or regular estrus, examined during diestrus (Fig. 13). Two cows having higher concentrations of both estradiol- 17β and 11-OHCS than the upper limits of the normal range conceived. In contrast, of 3 other cows showing lower concentrations of estradiol- 17β and 11-OHCS, 2 conceived.

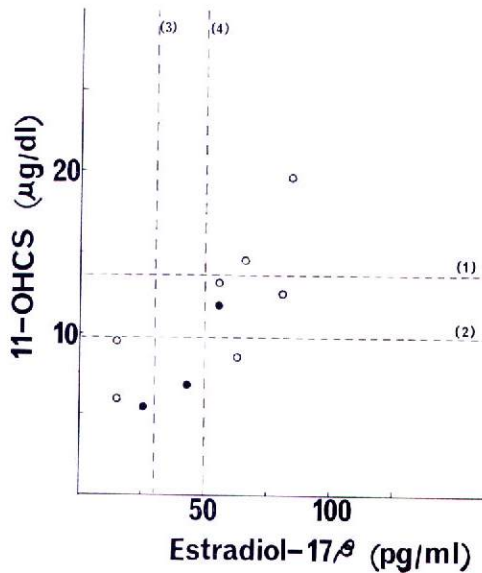


Fig. 13. Correlation between serum 11-OHCS and estradiol- 17β in cows with COD showing irregular or regular estrus which were examined during diestrus ($N=10$, $r=0.75$, $P\leq 0.01$).

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)-(2): Normal range.

(3)-(4): Normal range.

(2) Correlation between serum 11-OHCS increments and progesterone.

There was a positive correlation ($r=0.19$, not significant) between serum 11-OHCS increments and serum concentrations of progesterone in cows showing irregular estrus (Fig. 14). Of 8 cows having lower concentrations of progesterone than the upper limit of the normal range and showing a negative response to ACTH, only 3 conceived. On the other hand, 3 out of 4 cows having higher concentrations of progesterone than the upper limit of the normal range and showing increase of 11-OHCS in response to ACTH became pregnant.

(3) Correlation between serum concentrations of 11-OHCS and progesterone.

A negative correlation ($r=-0.12$, not significant) was observed between serum 11-OHCS and progesterone in cows with COD (Fig. 15). In cows having higher concentrations of progesterone in association with a higher concentration of 11-OHCS than the lower limits of the normal ranges, pregnancy rate was 84.8%, while in cows having either

lower concentrations of 11-OHCS or lower concentrations of progesterone than the lower limits of the normal ranges, pregnancy rate was only 70.9 %.

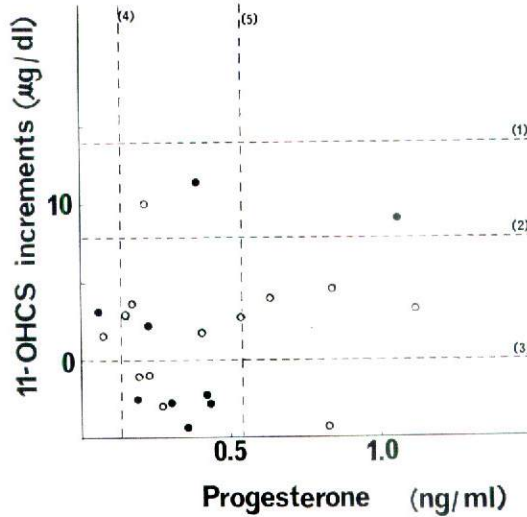


Fig. 14. Correlation between serum 11-OHCS increments and progesterone in cows with COD showing irregular estrus (N=22, $r=0.19$, not significant)

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)–(2): Normal range. (3): Zero increment level. (4)–(5): Normal range.

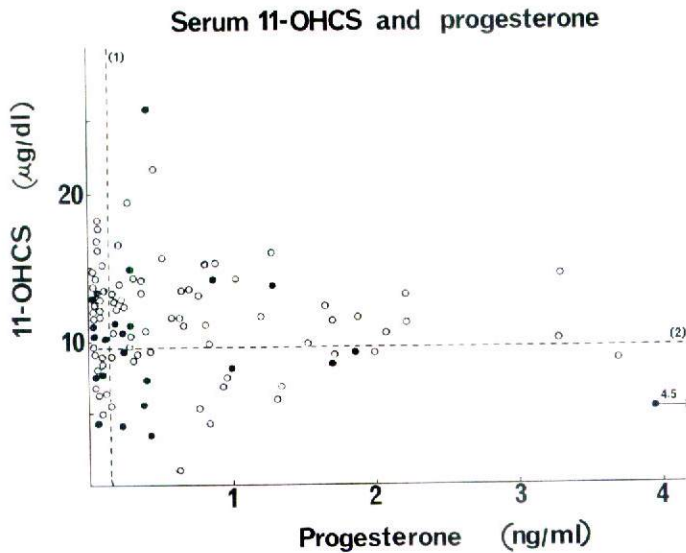


Fig. 15. Correlation between serum 11-OHCS and progesterone in cows with COD (N=102, $r=-0.12$, not significant).

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1): Lower limit of the normal range at estrus.

(2): Lower limit of the normal range.

5. Relationship of serum 11-OHCS to total serum protein and γ globulin in cows with COD with regard to prognosis.

(1) Correlation between serum 11-OHCS and total serum protein.

A significant correlation ($r = -0.23$, $P \leq 0.05$) was observed between serum 11-OHCS and total serum protein in cows with COD (Fig. 16). In 12 cows having both a higher concentration of total protein than the upper limit of the range in cows with COD, and a lower concentration of 11-OHCS than the lower limit of the normal range, pregnancy rate was 58.3%. In contrast, of 7 cows which had higher concentrations of 11-OHCS and lower concentrations of total protein than the upper limits of the normal ranges, 6 conceived (85.7%).

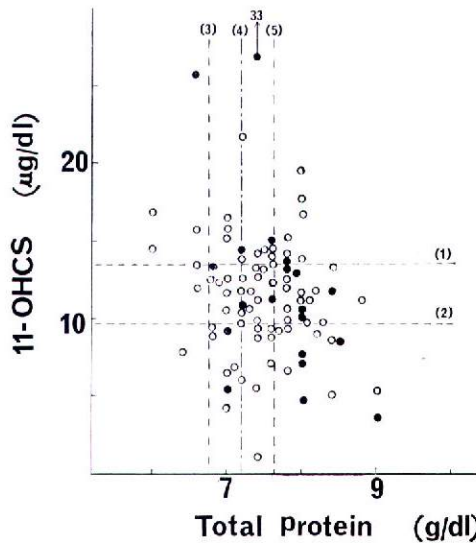


Fig. 16. Correlation between serum 11-OHCS and total serum protein in cows with COD ($N=92$, $r = -0.23$, $P \leq 0.05$).

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)-(2): Normal range.

(3)-(4): Normal range.

(5): Upper limit of range in cows with COD.

(2) Correlation between serum 11-OHCS and γ -globulin.

There was a significant correlation ($r = -0.38$, $P \leq 0.05$) between serum 11-OHCS and serum γ -globulin in cows with COD which show continuous or intense estrus (Fig. 17). In 8 cows having lower concentrations of 11-OHCS than the lower limit of the normal range and also having higher concentrations of γ -globulin than the upper limit of the normal range, pregnancy rate was 62.5%. On the other hand, all 4 cows which had higher concentrations of 11-OHCS and lower concentrations of γ -globulin than the lower limit of the normal range conceived.

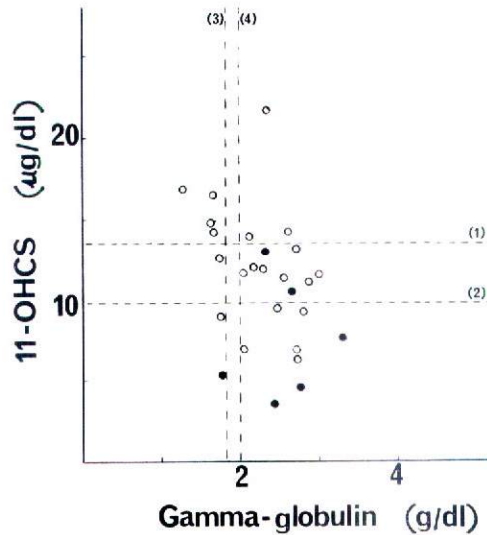


Fig. 17. Correlation between serum 11-OHCS and serum γ -globulin in cows with COD which exhibit continuous or intense estrus (N=27, $r = -0.38$, $P \leq 0.05$).

Note: White spots indicate cows which conceived and black spots indicate cows which failed to conceive.

(1)-(2): Normal range.

(3)-(4): Normal range.

6. Multiple-discriminant analysis.

As shown in Table 1, the discriminant score of the pregnant group was higher

Table 1. Results of multiple-discriminant analysis of data from cows with cystic ovaries showing intense or continuous estrus (Group I).

	Variables*											Discriminant score	
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI		XII
Ave. of pregnant cows	5.071	147.357	12.642	17.764	5.121	0.150	7.285	3.522	0.898	0.689	2.212	0.948	8.599
Ave. of failed cows	5.750	900.000	8.999	15.549	6.549	0.055	7.974	3.659	0.824	0.712	2.769	0.862	5.397
Differences in ave.	-0.679	-752.643	3.643	2.215	-1.428	0.095	-0.689	-0.137	0.074	-0.023	-0.557	0.086	
Ave. of total cows	5.222	314.611	11.833	17.272	5.438	0.129	7.438	3.552	0.882	0.694	2.336	0.929	7.894
Coefficient of L. D. F.**	0.5270-0.0023	0.0498	0.1014	-0.1044	1.3050	-6.3624	1.7260	8.3563	12.6270	7.7700	11.6600		
Ave. of early recovered cows	4.799	170.299	13.489	17.789	4.299	0.186	7.079	3.504	0.896	0.669	2.056	0.988	7.424
Ave. of late recovered cows	5.750	90.000	10.524	17.699	7.174	0.060	7.799	3.564	0.903	0.737	2.599	0.847	3.308
Differences in ave.	-0.951	80.299	2.965	0.090	-2.875	0.126	-0.720	-0.060	-0.006	-0.068	-0.543	0.141	
Coefficient of L. D. F.**	-0.8903	0.0084	1.4284	-1.4284	1.5519	5.9243	-7.5203	7.5291	15.1320	1.1491	6.3547	8.0098	

* Variables; I- age, II- interval after calving to diagnosis, III- serum 11-hydroxycorticosteroids, IV- serum 11-hydroxycorticosteroids 30 minutes subsequent to ACTH injection, V- serum 11-hydroxycorticosteroid increments, VI- serum progesterone, VII- total serum protein, VIII- albumin, IX- α -globulin, X- β -globulin, XI- γ -globulin, XII- albumin globulin ratio.

** L.D.F.; Linear discriminant function.

than that of the non recovering group within Group I (cows showing continuous or intense estrus). Besides, the discriminant score in cows conceiving earlier than 71 days after treatment was higher than that of cows conceiving after the 71st day. It was also found that among the 12 variables the intervals after calving up to diagnosis, serum 11-OHCS increments following ACTH injection, and total serum protein were negatively correlated with the discriminant score, while the others were positively correlated. Similar trends of the discriminant score, however, could not be found either in Group II (cows showing irregular or regular estrus) or in Group III (cows showing anestrus). This was resulted from the differences in linear discriminant function of each variable among the groups.

Discussion

Relationship between adrenocortical function and prognosis of COD;

It was found that cows having relatively high concentrations of 11-OHCS showed considerably higher pregnancy rates than those having low concentrations. Furthermore pregnancy rate in cows considered as having almost normal adrenocortical function as measured by serum 11-OHCS response to ACTH was markedly higher than those considered as having declined adrenocortical function. These findings are similar to those demonstrated by MIYAZAWA (1971). Since the difference in serum 11-OHCS and its response to ACTH is understood to be due to differences in the release of ACTH from the pituitary and on the potency of the adrenal cortex to secrete corticoids, it may be suggested that the action of exogenously administered corticosteroids to inhibit ACTH release was more dramatical in cows with high concentrations β of 11 OHCS associated with higher response to ACTH. This is probably connected with the highest pregnancy rate of cows showing anestrus.

Relationship between sex steroids and prognosis of COD;

In cows having relatively higher concentrations of progesterone, pregnancy rate was apparently higher than in cows with lower progesterone concentrations. And higher the progesterone concentrations, shorter is the interval from treatment to conception. This could be another explanation for the differences in prognosis among cows having different patterns of estrous behavior. Although there seemed to be no comparable data on the relationship between serum progesterone and prognosis of cows with COD, the results from this study indicate the role of adrenal progesterone in the onset and prognosis of COD. No relationship between serum estradiol-17 β and pregnancy could be demonstrated. However, there seemed to be an association between high estradiol-17 β concentration and a longer interval from treatment to conception. No explanation is attempted on this findings and also no comparable data is available. Works of SCARAMUZZI (1971) and LAMOND (1969), however, indicated that estrogens may inhibit LH release from hypothalamo-hypophyseal system and thus block ovulation. Therefore,

it may be possible that high estrogen concentrations have a negative effect on ovulation and corpus luteum formation in cows with COD.

Relationship between serum protein and prognosis of COD;

Cows having relatively high concentrations of total protein showed lower pregnancy rates than those having low concentrations. There is also a close association between total serum protein and days up to conception. The higher the concentrations of total protein, longer are the intervals from treatment to conception. These results are thought to be associated with a negative correlation between total serum protein and serum 11 OHCS which could have resulted from protein catabolism by corticosteroids. Findings on the relationship between serum γ -globulin and prognosis correspond with those of total serum protein and prognosis.

Relationship between adrenocortical function and sex steroids;

There seemed to be a functional correlation between adrenocortical function and serum concentrations of progesterone. Higher concentrations of serum 11-OHCS were found to be associated with lower concentrations of progesterone. And a positive correlation exists ($r=0.19$, $0.05 \leq P \leq 0.10$) between serum 11-OHCS increments following ACTH injection, which were negatively correlated with serum concentrations of 11-OHCS, and progesterone. These results indicate that the decrease of serum progesterone concentrations is in an opposite direction to the serum concentrations of 11-OHCS. Similar observation on the change in progesterone being opposite to that of glucocorticoids in cows at estrus and at parturition were reported by EDGERETON, *et al* (1973) and GIMÉNEZ, *et al* (1974). Furthermore is known that adrenal hyperactivities lead to an eventual inhibition of gonadotropic secretion and thereby glucocorticoids may alter the secretion of gonadotropic hormone (BALDWIN, *et al* 1974). These studies and the present study indicate the interaction between the adrenal cortex and the gonadal system. A positive correlation obtained between serum 11 OHCS and estradiol-17 β could be due to the stimulative action of estrogens on the adrenal cortex as described by GIVNER, *et al* (1972).

Multiple-discriminant analysis;

Results of the multiple-discriminant analysis of Group I indicate that it is possible to classify cows with cystic ovaries into three groups based on the data obtained with regard to age, interval after calving to diagnosis, serum 11-OHCS and its response to ACTH, serum progesterone, total serum protein, serum albumin, serum α -globulin, serum β -globulin, serum γ -globulin, and albumin globulin ratio at the time of diagnosis. The first group comprises of cows conceiving earlier than 71 days after treatment, and the second group, of cows conceiving after the 71st day, while the third group comprises of cows failing to conceive. Thus, especially in Group I, linear discriminant function could discriminate cows with COD into different groups which were divided according to prognosis. And the prognosis expressed by discriminant score corresponds to the prognosis

which was expressed by the experiences. However, since there were differences in discriminant scores between groups, it is suggested that more samples are to be analyzed to have the stability of linear function. The other variables which seemed to be correlated with the incidence and prognosis of COD also may be applied for the analysis.

Conclusions

1. Serum concentrations of 11-OHCS and the response to ACTH are understood to be closely correlated with pregnancy rates as well as the intervals from treatment to conception. Cows having relatively higher concentrations of 11-OHCS in association with a higher response to ACTH, recovered more readily.

2. Serum concentrations of progesterone were closely correlated with pregnancy rates and the intervals from treatment to conception. Most of the cows having relatively higher concentrations of progesterone conceived within shorter periods.

3. The relationship of total serum protein and γ -globulin values to prognosis was also demonstrated. In cows having higher concentrations of total protein or γ globulin, pregnancy rate was lower and the intervals from treatment to conception were longer.

4. A possible role of the adrenal cortex on the onset, estrous behavior, and prognosis of COD in dairy cattle was suggested by observing the relationship between adrenocortical function and serum concentrations of progesterone.

5. Significant correlations were observed between, serum 11-OHCS and total serum protein and γ globulin, serum 11-OHCS and serum estradiol-17 β , serum progesterone and total serum protein and γ -globulin, serum estradiol-17 β and total serum protein and γ -globulin ($P \leq 0.05$), respectively.

6. Multiple-discriminant analysis may be applied in the prognosis of COD from data on adrenocortical function, sex steroids and serum protein as well as age and the interval from calving to diagnosis in cows with COD.

Acknowledgement

The authors wish to thank Dr. S. TAMURA for permitting to carry out electrophoresis of serum protein and Dr. Y. KUBO for his valuable advice and help with the statistical analysis of data.

To all veterinary surgeons who helped in obtaining the materials and carrying out treatment trials, the authors wish to express their deep gratitude.

The donation of antiserum of sex steroids by Teikoku Hormone Mfg. Co. Ltd., Tokyo, and betamethasone by Shin Nihon Jitsugyo Co. Ltd., Tokyo, is acknowledged with thanks.

References

- 1) BALDWIN, D. M. and SAWYER, C. H. (1974): Effects of dexamethasone on LH release and ovulation in the cyclic rat. *Endocrinology*, **94**: 1397-1403.
- 2) EDGERTON, L. A. and HAFS, H. D. (1973): Serum luteinizing hormone, prolactin, glucocorticoid, and progesterin in dairy cows from calving to gestation. *J. Dairy Sci.*, **56**: 451-458.
- 3) GIMENEZ, T., ENDER, M. L. and HOFFMANN, B. (1974): Determination of physiological glucocor-

- ticoid levels in bovine peripheral plasma in relation to corpus luteum function during the estrus-cycle and after the application of an exogenous glucocorticoid. *Dt. tierärztl. Wschr.*, **81**: 33-37.
- 4) GIVNER, M. L. and ROCHEFORT, J. G. (1972): Effect of synthetic progestogens and estradio-17 β on adrenal function in the rat. *Endocrinology*, **90**: 1238-1244.
- 5) LAMOD, D. R. (1969): Ovulation block with stilboestrol in the cow. *J. Reprod. Fert.*, **18**: 359-361.
- 6) MIYAZAWA, K. (1972): Studies on the adrenocortical function in cows with cystic ovaries, with reference to ACTH test and serum 11-hydroxycorticosteroids. M. S. Thesis, Library of Obihiro University of Agriculture and Veterinary Medicine. (In Japanese with English summary).
- 7) NAKAO, T. ONO, H., SATO, K. and MIYAKE, M. (1975)^a: Studies on cystic ovarian disease in dairy cattle. I. Adrenocortical function, serum concentrations of sex steroids and serum protein pattern in cows with normal estrous cycles and cows with cystic ovaries. *Res. Bull. Obihiro Univ.*, **9**: 394-416.
- 8) NAKAO, T. ONO, H., SATO, K. and MIYAKE, M. (1975)^b: Studies on cystic ovarian disease in dairy cattle. II. Therapeutic efficacy of an intramuscular injection of corticosteroids. *Res. Bull. Obihiro Univ.*, **9**: 417-422.
- 9) SCARAMUZZI, R. J., TILLSON, S. A., THORNEYCROFT, I. H. and CALDWELL, B. V. (1971): Action of exogenous progesterone and estrogen on behavioral estrus and luteinizing hormone levels in the ovariectomized ewe. *Endocrinology*, **88**: 1184-1189.

摘 要

著者らは先に、卵胞嚢腫牛の副腎皮質機能並びに血中性ステロイド値は外部徴候と密接な関係にあること、また合成副腎皮質ホルモンによる治療成績も外部徴候によって異なることを明らかにした。今回は、卵胞嚢腫牛における副腎皮質機能、血中性ステロイド値並びに血清蛋白像と予後との関係について検討を加えた。

1. 血中 11-OHCS 値が高く、しかも ACTH に対する反応性の高いものほど治癒率は高く、受胎までの日数も短かった。
2. 血中 Progesterone 値の高いものほど治癒率は高く、受胎までの日数も短かった。
3. 血中 Estradiol-17 β 値と治癒率の間に一定の関係はみられなかったが、高い値を示すものほど受胎までの日数は長い傾向にあった。
4. 血清総蛋白および γ -globulin 値の高いものほど治癒率は低く、受胎までの日数は長かった。
5. 線型判別函数分析による判別値は、不治癒群に比べ治癒群で高く、また治癒群の中でも初回治療後 70 日以内に治癒したものでは 71 日以後に治癒したものに比べ高かった。したがって、この方法により卵胞嚢腫の予後判定が可能であることがわかった。

以上の結果から、副腎皮質機能、血中性ステロイド値並びに血清蛋白像は卵胞嚢腫の予後と密接な関係にあることが明らかにされた。