



# Reproductive Endocrinology

## REPRODUCTIVE HORMONE CONCENTRATIONS IN STALLIONS WITH BREEDING PROBLEMS: CASE STUDIES

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### SUMMARY

Plasma concentrations of LH, FSH and testosterone are reported in stallions exhibiting a variety of reproductive problems. Stallions with poor libido were found to have low LH and FSH concentrations, while testosterone concentrations appeared normal. Stallions with good libido but experiencing ejaculatory disorders had normal concentrations of LH, FSH and testosterone. Older stallions experiencing a marked reduction in fertility had elevated FSH concentrations which were accompanied by increased LH concentrations in some cases, however, testosterone concentrations appeared normal in such stallions. Two young stallions which had experienced poor fertility (40 to 60% conception rates) from the beginning of their stud careers were found to have normal FSH and testosterone concentrations while LH concentrations were consistently low in one and normal in the other.

### INTRODUCTION

With the recent completion of a year long study designed to establish normal plasma hormone concentrations in a large population of stallions,<sup>3</sup> we have had the opportunity to study a small number of stallions exhibiting a variety of reproductive problems. Since many of these stallions were observed to have marked hormonal imbalances, several of which had not

been previously reported, it was decided to report these observations and discuss how hormone concentrations in these stallions differ from those in normal stallions.

### MATERIALS AND METHODS

Plasma concentrations of several reproductive hormones in 13 stallions between the ages of 4 and 29 years old were measured. Early morning (7 to 10 A.M.) blood samples were collected, plasma was separated and stored at  $-20^{\circ}\text{C}$  for subsequent hormone quantification. Plasma concentrations of LH, FSH and testosterone were determined by radioimmunoassay as previously described.<sup>2</sup> Within the range of values obtained the intra- and inter-assay coefficients of variation (CV) were less than 10% for each hormone measured. All assay data were calculated using a logit-log linear transformation program.

### RESULTS

#### Cases 1-4

Four stallions were found to be suffering from "organic impotence" as defined by Cooper et al. (1972).<sup>4</sup> In general, all 4 stallions displayed poor libido, appearing uninterested in estrous mares. Endocrine assessment of stallions 1 through 4 revealed low plasma LH concentrations in each case with a mean concentration of  $0.32 \pm .1$  ng/ml ( $\bar{x} \pm \text{SE}$ ) which is well below concentrations observed in normal stallions<sup>3</sup> which range from a low of  $1.53 \pm 0.23$  ng/ml in December to a high of  $5.95 \pm 0.85$  ng/ml in May ( $\bar{x} \pm \text{SE}$ ,  $n = 44$ ). Plasma FSH concentrations were also found to be low, averaging  $0.68 \pm 0.1$  ng/ml compared with normal stallions<sup>3</sup> whose FSH concentrations range from  $2.4 \pm 0.25$  ng/ml

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in November to a high of  $3.12 \pm 0.28$  ng/ml in May ( $\bar{x} \pm SE$ ,  $n = 44$ ). Testosterone concentrations appeared normal in all four stallions compared to values in normal stallions for that time of year.

#### Cases 5-6

Two stallions displayed behavior similar to what is often termed "psychogenic impotence" in that both stallions had good libido but usually failed to ejaculate, often after normal penile erection and intromission. Both stallion 5 and 6 were found to have normal LH, FSH and testosterone concentrations.

#### Case 7-9

These three stallions were all older stallions from 20 to 29 years old which had either been retired due to a loss of fertility or were currently exhibiting fertility problems. Blood samples were collected at monthly intervals between December 1981 and December 1982. Stallion 7 had been retired in 1977 after failing to settle any mares during the 1976 breeding season at the age of 23. Endocrine assessment of stallion 7 which was maintained under ambient photoperiodic conditions revealed normal plasma concentrations of testosterone throughout the year. However, LH concentrations were elevated and ranged from a low of 10.1 ng/ml in December to a high of 50 ng/ml in July and FSH concentrations were extremely high (48 to 77 ng/ml) during the entire year.

Stallion 8 was retired in 1976 after a poor 1975 season at age 22 and was maintained under increased photoperiod (16 hours light/day, beginning December 15, 1981) during the 1982 breeding season. During the period of study, stallion 8 exhibited normal testosterone and LH concentrations. However, as observed in stallion 7, FSH concentrations were elevated (8.5 to 24 ng/ml) during the entire 13 month period.

Stallion 9, age 20, had experienced poor fertility during the 1981 season (26%). During the 1982 breeding season, his breeding schedule was reduced to one mare every other day which appeared to be beneficial, resulting in a 52% conception rate for the 1982 season. However, recent figures indicate only a 29% conception rate was achieved in 1983. Again, as with stallion 8, testosterone and LH concentrations appeared normal and FSH concentrations were elevated (8.7 to 16 ng/ml) during the entire 13 month period.

#### Case 10

Case 10 was a 22-year-old-stallion which had previously been studied during the 1980 breeding season and had normal LH and FSH concentrations through March 31, 1980 and achieved a 79% rate that year. During the 1981 and 1982 breeding seasons, his conception rates had dropped to 51 and 55%, respectively. Endocrine assessment during 1982 revealed normal LH and testosterone levels. However, FSH concentrations averaged 6.2 ng/ml during the 1982 breeding season or 2.7 times higher than in 1980. FSH concentrations increased further that year to above 10 ng/ml by October and remained elevated (greater than 10 ng/ml) during November and December. Recent records indicate that only one mare out of 26 conceived to stallion 10 in 1983.

#### Case 11

Case 11 was a 22-year-old-stallion which had experienced a marked decrease in fertility during the 1982 breeding season. Endocrine assessment of June and July 1982 samples from this stallion showed normal testosterone and LH concentrations while FSH concentrations were elevated (22.4 ng/ml and 21.6 ng/ml).

#### Case 12

Case 12 was a 6-year-old-stallion which consistently has settled less than 60% of his mares in several years at stud. Endocrine assessment at two week intervals prior to and well into the breeding season revealed consistently low LH concentrations of less than 1 ng/ml while FSH and testosterone concentrations were normal.

#### Case 13

Case 13 was a 7-year-old-stallion which consistently settled less than 60% of his mares in several years at stud. Endocrine assessment of stallion 13 at several times during the 1982 breeding season revealed normal plasma concentrations of LH, FSH and testosterone in all samples studied.

## DISCUSSION

The observation that each of the 4 "organically impotent" stallions (cases 1 through 4) had low plasma LH concentrations yet normal testosterone concentrations agrees well with a previous study.<sup>18</sup> These authors also demonstrated that such stallions had significantly lower estradiol-17B concentrations than normal stallions. Furthermore, each of the four stallions in the present study had low FSH concentrations, which previously had not been associated with impotence in stallions. The fact that these stallions had low LH and FSH concentrations suggests that decreased synthesis or secretion of GnRH or decreased pituitary responsiveness to endogenous GnRH may be responsible for this type of "organic impotence".

Several studies in hypogonadal men with hypothalamic or pituitary dysfunction resulting in "organic impotence" have reported increased libido and potency between two and 30 days after beginning GnRH therapy.<sup>1 8 9 15</sup> Moreover, in two of the studies, testosterone concentrations were well below the normal range in all but two men.<sup>8 9</sup> The rapid return of potency in these patients despite low testosterone concentrations normally associated with organic impotence suggested such behavioral effects may not be entirely androgen mediated and is suggestive of a physiological role for endogenous GnRH in maintenance of normal sexual behavior. Studies in both intact<sup>5 10 11</sup> and castrated<sup>6 12</sup> rats have also suggested that GnRH may play a role in maintenance of normal sexual behavior.

The observation that organically impotent stallions have normal testosterone concentrations but reduced estradiol-17B concentrations<sup>18</sup> differs from low testosterone but normal estradiol concentrations which are commonly seen in organically impotent men.<sup>8</sup> Since estradiol-17B alone was able to restore libido in

geldings,<sup>16</sup> and is low in stallions experiencing poor libido,<sup>18</sup> it seems possible that maintenance of libido in intact stallions is at least in part estradiol dependent.

The findings that stallions 5 and 6 which most likely were suffering from psychogenic impotence had normal LH, FSH and testosterone concentrations agree with observations on one such stallion by Wallach et al.<sup>18</sup> which had normal LH, testosterone, and estradiol-17B concentrations. Of the various types of psychogenic impotence reported in stallions, ejaculatory disorders appear to be among the most common and have been described by several researchers.<sup>14-17</sup> The recent observation that a high percentage of such stallions respond to treatment designed to block beta receptors and stimulate alpha receptors in the sympathetic nervous system<sup>7</sup> suggests that such problems are most likely not endocrine in nature. Further evidence to support this conclusion comes from the observation that changes in management practices or retraining of stallions with ejaculatory disorders can sometimes be beneficial.<sup>13-14</sup>

The finding of elevated concentrations of FSH in stallions with a marked reduction in fertility (cases 7-11) agrees with observations in men where a reciprocal relationship between plasma FSH concentrations and the degree of seminiferous tubular damage or germ cell depletion has been demonstrated.<sup>19</sup> In a previous study,<sup>3</sup> it was observed that plasma FSH concentrations were significantly elevated in fertile older stallions (greater than 15 years old) ( $\bar{x}$ =3.5 - 6.0 ng/ml) compared to younger stallions ( $\bar{x}$ =2-3 ng/ml). However, concentrations are considerably higher in older subfertile stallions. Based on information reported in the present study, plasma FSH concentrations might be very useful in the assessment of seminiferous tubular damage or testicular degeneration in the stallion.

The seemingly normal Leydig cell function, as indicated by normal testosterone secretion in stallion 7, in which LH concentrations went as high as 50 ng/ml is difficult to explain. However, three other stallions with normal fertility have also been observed to have normal testosterone concentrations even though their LH concentrations were four to five times higher than normal values during the entire year. Moreover, normal testosterone secretion appears to be maintained in stallions with low LH concentrations associated with reduced fertility<sup>2</sup> or organic impotence.<sup>18</sup>

The finding of low LH but normal testosterone and FSH concentrations in stallion 12 is similar to previous observations in lighted low fertility stallions.<sup>2</sup> Recent re-examination of the data from that experiment has indicated that four out of five of these stallions were young (between 4-7 years old) suggesting the possibility that this type of problem may be more common in younger stallions. Hopefully, further research in this area may better define the relationship between low LH and reduced fertility.

The observations of normal concentrations of LH, FSH and testosterone concentrations in stallion number 13 is important because it points out that not all fertility

problems in stallions are related to these hormones. However, we feel these results do suggest that endocrine assessment is a valuable tool for veterinarians and stud managers and is an area where further extensive research is needed.

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