Endocrine Changes Associated With Heat Stress Of Gilts After Breeding

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Story in Brief

Twenty-four crossbred gilts (Yorkshire X Hampshire) were used to evaluate endocrine function in gilts during and after exposure to elevated ambient temperature on days 1 through 8 postbreeding. Cannulae were placed in the anterior venae cavae of gilts 6 to 12 days prior to estrus. Gilts were mated to a boar on the first day of estrus (day 0) and were artificially inseminated on day 1. Heat stressed gilts were exposed to 35±1 C for 12 hr and 32±1 C for 12 hr daily. Control gilts were maintained at 23±1 C. Gilts were bled at 8 am and 8 pm on days 1 through 8 and were removed from the environmental chambers at 8 pm on day 8 and were bled once daily through day 22 postbreeding. Respiratory rates and rectal temperatures were greater in heat stressed than control gilts. Plasma progesterone in nonpregnant gilts was greater in heat stressed than in control gilts during days 9 to 13 postbreeding. Plasma concentrations of LH and total corticoids in nonpregnant heat stressed and control gilts were similar during exposure to elevated ambient temperature, but plasma estradiol concentrations were slightly reduced during heat stress.

Introduction

With an increase in the number of large scale swine confinement systems, farrowing occurs during all months of the year. Reduced litter size and decreased conception rates have been observed during the months of elevated ambient temperatures.

It has been demonstrated that exposure of gilts to elevated ambient temperature from 0 to 16 days postbreeding results in lowered conception rates and reduced litter size at 30 days postbreeding. However, the physiological causes of this reduced reproductive performance following heat stress in gilts is unknown.

The reduction in sow reproductive performance could be the result of a direct effect of elevated body temperatures upon the embryo or it could be related to changes in the uterine environment caused by alterations in endo-

crine function. These changes in the uterine environment could affect the ova prior to fertilization, or interfere with the development and implantation of the fertilized ova.

Plasma hormone concentrations associated with early pregnancy and embryogenesis in swine have been studied; however, little information is available on the effects of elevated ambient temperature on endocrine function in gilts. An evaluation of these changes could lead to the development of management practices which would result in improved reproductive performance in swine.

This study was designed to determine the effects of heat stress of gilts on conception rates, embryo survival and on plasma concentrations of progesterone, estradiol, LH and corticoids.

Materials and Methods

Twenty-four crossbred (Yorkshire × Hampshire) gilts, 7 to 12 months of age, were used in this study conducted during the months of July through December.

A boar was used once daily to check gilts for estrus. After each gilt had exhibited at least one normal estrous cycle, and 6 to 12 days prior to expected estrus, gilts were anesthetized with sodium thiopental and cannulae were inserted into the anterior venae cavae.

Gilts were allowed to mate with a boar on the first day of estrus (day 0) and were artificially inseminated on day 1. A blood sample was collected immediately after breeding at 8 am on day 0 and another sample was obtained at 8 pm, then the gilts were randomly allotted to either cool or hot environmental chambers. The cool chamber was maintained at 23±1 C and the hot chamber was maintained at 35±1 C from 8 am to 8 pm and at 32±1 C from 8 pm to 8 am. Gilts in each chamber were confined in two 2 × 5 ft crates and were exposed to 12 hr of artificial light daily (8 am to 8 pm) with 50 percent relative humidity.

During confinement gilts were bled daily at 8 am and 8 pm. Gilts were given 4 lb of feed at each bleeding and water was provided free choice. At 8 pm on day 8, gilts were removed from the environmental chamber and returned to the swine barn where the ambient temperature ranged from 10 to 27 C. They were maintained in individual crates or pens and blood samples were collected once daily through day 22 postbreeding. Gilts were slaughtered at 32±5 days postbreeding and numbers of embryos and corpora lutea were determined.

Plasma concentrations of progesterone, estradiol, corticoids and luteinizing hormone were quantified by specific radioimmunoassays that have been validated in our laboratory.

Results and Discussion

Three of 12 control gilts and 1 of 12 heat stressed gilts were pregnant at slaughter on day 32 after estrus. Pregnant control gilts had an average of 13.7±.3 corpora lutea and 11.3±1.2 embryos compared to 13 corpora lutea and 8 embryos in the one pregnant heat stressed gilt. Poor conception rates for gilts on both treatments may have been due to boar infertility rather than to cannulation and daily bleeding or chamber confinement. In preliminary trials using the same chambers and cannulation technique, normal conception rates (70 to 80 percent) were obtained.

The ambient temperatures to which the heat stressed gilts were exposed in this experiment were similar to those used by Omtvedt *et al.* (1971) which caused a reduction in conception rate and reduced embryonic survival. Water consumption during treatment was similar for heat stressed and control gilts, but feed consumption was reduced in heat stressed gilts.

Average respiratory rates were significantly greater at 8 pm for heat stressed gilts compared to control gilts (Figure 1). Respiratory rates in heat stressed gilts at 8 pm were significantly greater than the 8 am respiratory rates in stressed gilts. This difference in the 8 am and 8 pm respiratory rates of heat stressed gilts was probably due to the lower temperature the gilts were exposed to during the night.

Rectal temperatures of the heat stressed gilts (Figure 2) at 8 am were significantly greater than the temperature of control gilts at 8 am. The 8 pm temperatures in stressed gilts were greater than the 8 am temperatures in stressed gilts (40.7±.1 *vs* 39.9±.1 C, respectively). Rectal temperatures increased slightly in all gilts for the first four days of confinement then decreased during the last four days of confinement. Similar to other studies, this suggests that gilts may compensate to exposure to heat stress and rectal temperatures are reduced after several days of exposure. In our trial, there was a simple correlation of 0.45 ($P<.05$) between rectal temperature and respiratory rate of all gilts.

Plasma progesterone, estradiol, LH and corticoid concentrations on day 0 (prior to treatment) were similar for control and heat stressed gilts (Table 1). Since conception rates were reduced for both treatments, an interpretation of comparisons between one pregnant stressed gilt and three pregnant control gilts would have little meaning. Pregnant gilts were omitted from the analyses of endocrine data and comparisons between treatments were limited to non-pregnant gilts.

Plasma progesterone, corticoids, estradiol and LH were not significantly different between 8 am and 8 pm samples taken during chamber confinement. Plasma progesterone concentrations tended to be greater in stressed gilts than in control gilts during the treatment period (Figure 3). Plasma progesterone concentrations during days 9 to 13 after estrus (immediately post-treatment

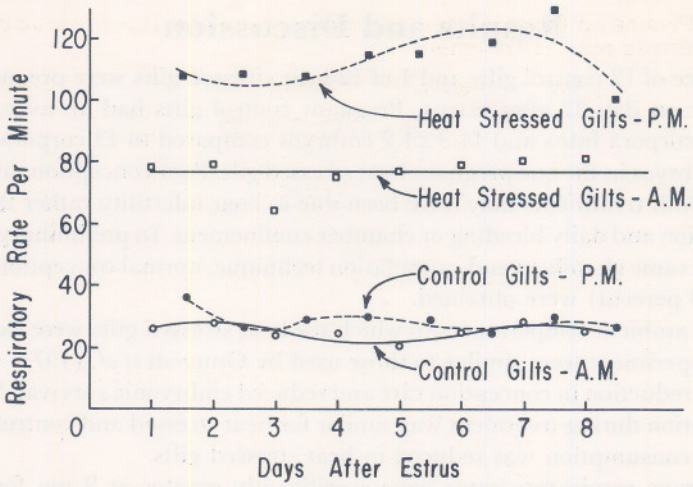

Figure 1. Respiratory rates of gilts during exposure to control or elevated ambient temperature

In the a.m., heat stressed gilts had been exposed to 32 C for the preceeding 12 hr and in the p.m. heat stressed gilts had been exposed to 35 C for the preceeding 12 hr. Control gilts were maintained at 23 C.

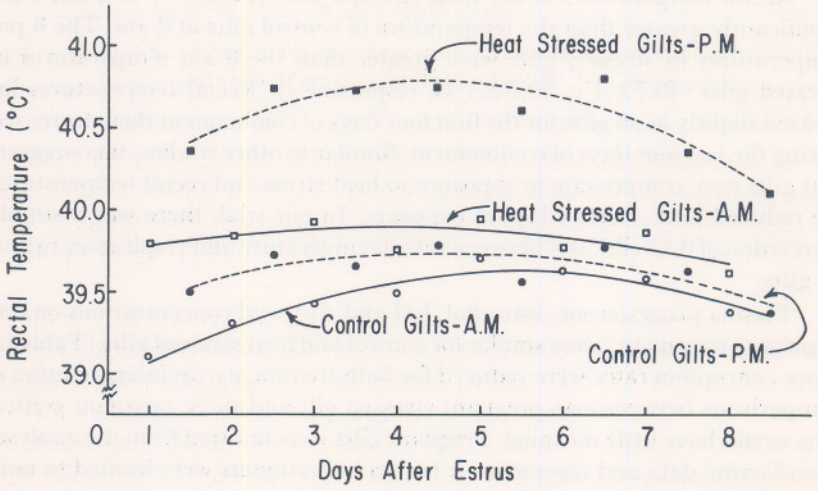

Figure 2. Rectal temperatures of gilts during exposure to control or elevated ambient temperature

In the a.m., heat stressed gilts had been exposed to 32 C for the preceeding 12 hr and in the p.m. heat stressed gilts had been exposed to 35 C for the preceeding 12 hr. Control gilts were maintained at 23 C.

Table 1. Plasma hormone concentrations in control and heat stressed gilts at estrus prior to treatment

Treatment Group	Gilts	Progesterone	Estradiol	LH	Corticoids
	(no.)	(ng/ml)	(pg/ml)	(ng/ml)	(ng/ml)
Control	12	1.0± 0.2[a]	18.1±3.7	17.4±5.1	30.4±5.7
Heat stressed	12	1.1±0.2	14.9±3.7	17.7±5.1	39.5± 5.7

[a]Mean ± S.E.

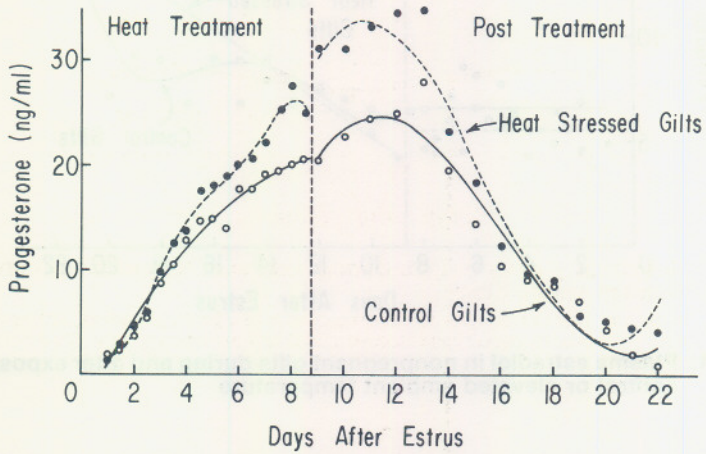

Figure 3. Plasma progesterone in nonpregnant gilts during and after exposure to control or elevated ambient temperature

period) were significantly greater in stressed gilts than in control gilts. Progesterone in control gilts increased from 1 ng/ml on day 1 to about 25 ng/ml on day 12, then decreased rapidly to about 2 ng/ml on day 21 after estrus. These changes in progesterone during the estrous cycle are similar to those reported previously.

Progesterone concentrations in heat stressed gilts increased from about 2 ng/ml on day 1 to a maximum of 34 ng/ml on day 12, then decreased to 3 ng/ml by day 20. Similar to these results, Florida workers have observed elevated plasma progestins in heifers exposed to elevated ambient temperatures during the first three days after breeding. The adrenal cortex could be the source of increased plasma progesterone in heat stressed gilts, since others have observed that gilts exposed to elevated ambient temperatures had about a two-fold increase in plasma ACTH concentrations and plasma corticoids were slightly reduced or unchanged. Similarly, injection of ACTH caused increases in both corticoids and progesterone in heifers.

Plasma estradiol concentrations were slightly reduced in heat stressed gilts during treatment, but the response was not significantly different from control gilts after chamber confinement (Figure 4). During treatment, es-

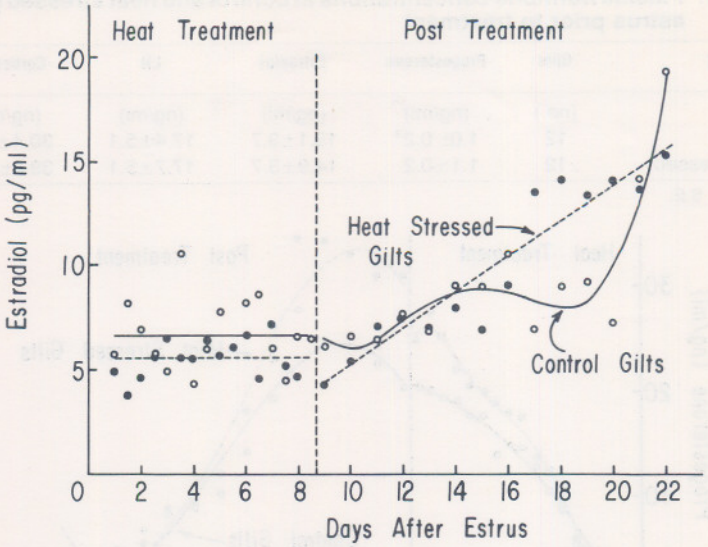

Figure 4. Plasma estradiol in nonpregnant gilts during and after exposure to control or elevated ambient temperature

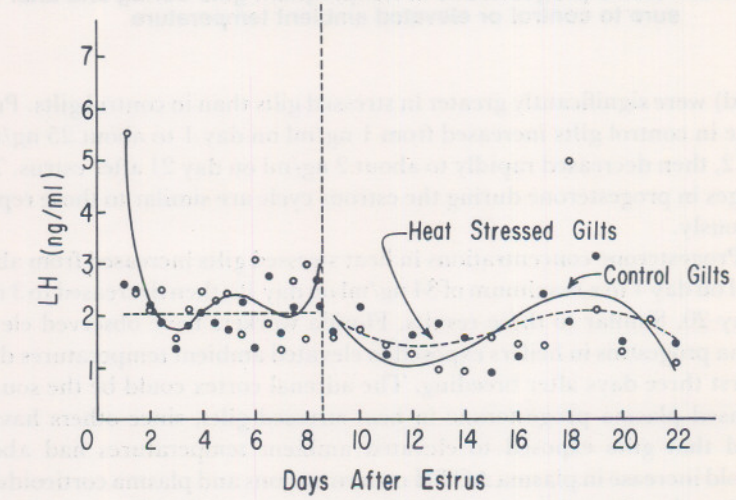

Figure 5. Plasma LH (as NIH-LH-S_{18}) in nonpregnant gilts during and after exposure to control or elevated ambient temperature

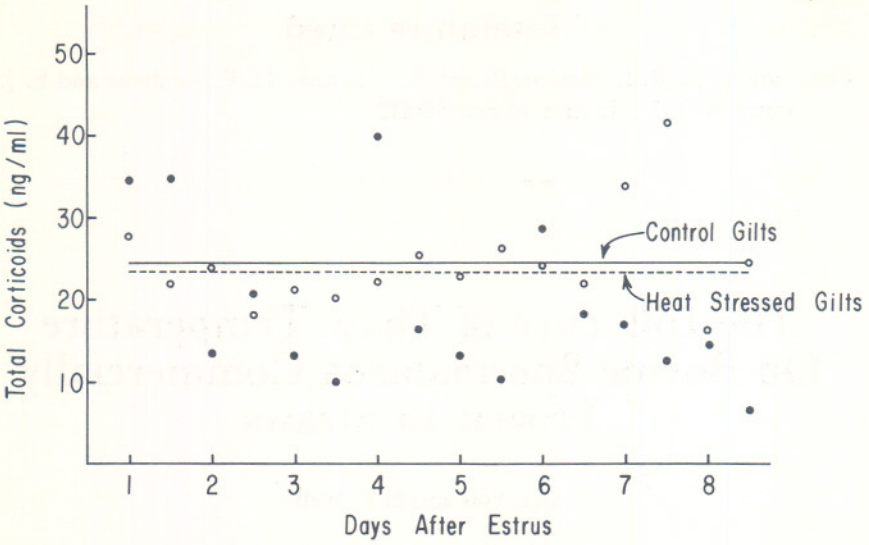

Figure 6. Plasma corticoids in nonpregnant gilts during exposure to control or elevated ambient temperature

tradiol averaged 6.7±.5 pg/ml in control gilts and 5.6±.5 pg/ml in stressed gilts. After treatment, estradiol in control gilts increased from 6 pg/ml on day 9 to 20 pg/ml on day 22, and estradiol in heat stressed gilts increased from 4 pg/ml on day 9 to 15 pg/ml on day 22. The proestrus increase in plasma estradiol which occured in control and stressed gilts was similar to increases in estrogens reported previously.

Mean plasma LH concentration (Figure 5) in control and heat stressed gilts was not different either during or after treatment. Reduced base line as well as peak plasma LH in cows exposed to elevated ambient temperature has been reported by other workers.

Plasma concentrations of total corticoids were not significantly affected by exposure of gilts to elevated ambient temperature (Figure 6). During treatment, corticoid concentrations in control gilts averaged 24.6±2.8 ng/ml compared to 23.5±4.7 ng/ml in heat stressed gilts. Average plasma corticoids for different periods ranged from 10 to 43 ng/ml.

Results of this study indicate that exposure of gilts to elevated ambient temperatures during days 1 through 8 after breeding causes increased plasma progesterone concentrations but plasma LH, estradiol and corticoids are not significantly altered. It is not known whether the increase in plasma progesterone is of sufficient magnitude to alter conception rate or embryonic survival.

Literature Cited

Omtvedt, I. T., R. E. Nelson, Ronnie L. Edwards, D. F. Stephens and E. J. Turman; 1971; J. Animal Sci. 32:312.

The Influence of Thaw Temperature On Bovine Spermatazoa Commercially Frozen In Straws

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Story in Brief

Bovine semen commercially frozen and packaged in .5 ml straws, was subjected to thaw temperatures of 32 F, 68 F, 95 F and 203 F for 2 min, 1 min, 20 sec and 7 sec, respectively. Following completion of thawing, the semen was incubated at 98.6 F for either 5 min, 1 hr, 3 hr or 5 hr. The effects of these treatments were evaluated by changes in the percentage of "live" cells and changes in cell structure during the incubation periods. Faster thaw rates increased the percentages of "live" cells and cells showing no alteration of the acrosome. Of the four thaw temperatures, the 95 F/20 sec provided more live cells of desirable type than the others.

Introduction

The artificial insemination industry currently utilizes several semen packaging methods in selling semen to the public. The most recent package consists of a plastic straw, or tube, which normally contains either .3 ml or .5 ml extended semen. The straw shape and size is substantially different from the conventional glass ampule. Several problems have become apparent as breeders have used recommended ampule thawing procedures for the straw. The major problems have been poor cell viability post-thaw and variable fertility.

The straw semen packaging system was introduced before research had defined optimum handling procedures. Various straw thawing techniques are common. These include thawing in the cow, thawing between the hands,