

# Effect of different types of textiles on pregnancy

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## Summary

**Purpose of investigation:** The effect of different types of textiles on pregnancy was studied in 35 pregnant bitches divided equally into one control and four experimental groups. **Methods:** During pregnancy, the test groups were dressed in a garment made of either pure polyester, cotton or wool, or of a 50/50% polyester-cotton mix. Serum estradiol 17 B and progesterone were measured before and every 15 days during pregnancy. Electrostatic potential (EP) was assessed on the skin before and after wearing the garment. **Results:** The bitches wearing cotton, wool and polyester-cotton mix as well as five of the seven wearing pure polyester garments had normal serum estradiol and progesterone during pregnancy and produced normal offspring. The remaining two animals of the group wearing pure polyester showed low serum progesterone levels in the first month of pregnancy and had spontaneous abortions. Mating was attempted in these two bitches during the subsequent estrous cycle without making them wear polyester garments. Serum levels of reproductive hormones were normal and they produced normal offspring. EP was detected on the skin of only the polyester-dressed groups, and was higher in the pure than in the mixed polyester groups. **Conclusions:** The cause of low serum progesterone and abortion in the two bitches is unknown. Abortion seemed to be due to the low serum progesterone which may have resulted from the injurious effect of EP on the ovarian or placental function.

**Key words:** Pregnancy; Abortion; Textiles; Polyester; Hormones.

## Introduction

Female infertility is due to several causes including ovulatory defects, tubal and cervicouterine factors, and endometriosis [1-5]. Unexplained infertility occurs in 5% to 15% [1-4]. In a study on female dogs wearing polyester-blend underwear led to anovulation and non-luteinization as well as failure to conceive in 57% of the cases [6]. The sterile effect seems to be related to electrostatic potential generated on the skin, due to the friction between the skin and the polyester underwear. It was suggested that an electrostatic field is created which may affect the ovaries with resulting anovulation [6]. In contrast, cotton and wool underwear did not generate electrostatic potential and had no effect on conception. Other studies have been done on the effect of electrostatic potential on spermatogenesis [7-9], sexual activity [10, 11], and hair growth [12]. The question is, could the different types of textiles affect the already pregnant female? The answer could not be traced in the literature. Consequently, the present study on the effect of different types of textiles on pregnant dogs was carried out. This study was approved by the Medical Faculty Review Board.

Female dogs experience two estrous periods a year; each cycle has five phases: proestrus, estrus, metestrus, diestrus and anestrus [13-15]. Proestrus lasts for nine days and is characterized by vulval swelling and increased estrogen levels. It ends at the time of the first male acceptance (coitus). Estrus lasts for a mean of nine days during which there are declining plasma estrogens, increased plasma progesterones, male acceptance and ovulation. In the metestrus/diestrus phase, the corpus

luteum becomes functional in the former and fully functional in the latter. Anestrus is a quiescent period of the reproductive organs with low levels of reproductive hormones and absence of sexual behavior. Duration of the gestation period is approximately 60 days [13-15].

## Patients and Method

Thirty-five pregnant bitches were studied. The mean weight was  $17 \pm 4.2$  SD/kg (range 12 to 19 kg). They were selected because they had normal reproductive hormone levels. The serum estradiol 17 B and progesterone, determined during the anestrus and estrus periods of the estrous cycle, were within normal limits. After mating, pregnancy was diagnosed by ultrasonography in the early stage of gestation and later on by abdominal palpation. The bitches were divided into five equal groups: four test groups and one control. Group 1 was dressed in garments made of 100% polyester (polyethylene terephthalate) group two in 50/50% polyester/cotton mix, group three in 100% cotton, and group four in 100% wool. The bitches in the fifth group were left undressed and acted as controls.

The garment was fashioned to cover the dog's abdomen, back and perineum as well as the upper parts of the fore- and hindlimbs. Two openings were made: one for the tail and one for the vaginal, urethral and anal orifices. The garments were worn day and night until the time of parturition. They were changed for fresh ones whenever soiled.

## Hormonal assay

Serum estradiol 17 B and progesterone were determined before pregnancy in the anestrus and estrus periods of the estrous cycle, and every 15 days during pregnancy until the time of parturition. The hormones were measured by radioimmunoassay using Diagnostic Products Corporation Kits (Medical Technologies, San Francisco, CA). Blood sampling for hormonal measurements was taken at about the same time of day to avoid circadian differences.

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### Measurement of the electrostatic potential

The electrostatic potential (EP) on the skin of all groups of dogs was measured before and after wearing the clothing. The EP generated by the friction between the different textile covers and the skin of the dog was measured during the morning hours between 9 and 11 am. The mean room temperature was  $27^{\circ}\text{C} \pm 4.1$  (range  $23^{\circ}$  to  $32^{\circ}\text{C}$ ). This was repeated at least four times, each on a separate day, and the mean for each dog was calculated. The apparatus used for measuring the electrostatic potentials was the electrostatic kilovoltmeter (Model LVE, Hallmark Standards, Cleveland, OH) with a sensitive probe. The measurements were recorded as volt/unit area of the probe. The technique comprised applying the probe to the textile-covered area of the skin at different sites, and taking the reading from each site. The mean of these readings was calculated.

To ensure reproducibility of the results, the measurements were repeated at least twice in the individual animal and the mean value was calculated. Results were analyzed statistically using the Student's t-test and values were reported as mean  $\pm$  standard deviation (SD). Significance was ascribed to  $p < 0.05$ .

## Results

### Hormone level

No complications were encountered during the study period. Before wearing the clothing, the median level of serum estradiol 17 B was  $6.9 \pm 2.4$  and  $6.5 \pm 1.7$  pg/ml in all bitches, and of serum progesterone  $0.40$  and  $59.2 \pm 23.4$  ng/ml in the anestrus and estrus phases, respectively (Table 1). These figures compared with the normal levels in our laboratory and with those of other investigators [16-18].

Table 1. — Serum estradiol 17 B and progesterone before and after pregnancy in control dogs.

	Estradiol (pg/ml)		Progesterone (ng/ml)	
	Mean	Range	Mean	Range
<i>Before pregnancy</i>				
Anestrus	$6.9 \pm 2.4$	4-10	0.40	0.3-0.55
Estrus	$6.5 \pm 1.7$	3-10	$59.2 \pm 23.4$	25-88
<i>After pregnancy</i>				
1/2 month	$7.8 \pm 1.9$	5-14	$60.4 \pm 24.9$	23-90
1 month	$11.7 \pm 3.6$	9-20	$57.9 \pm 22.4$	24-82
1 1/2 months	$23.4 \pm 6.1$	18-34	$37.3 \pm 16.3$	15-52
2 months	$29.8 \pm 7.2$	22-40	$10.6 \pm 3.2$	5-18

+ values are given as mean  $\pm$  SD.

During the two months of pregnancy of the controls, the level of serum estradiol 17 B showed a progressive increase from a mean of  $6.5 \pm 1.7$  pg/ml in the estrus phase to  $29.8 \pm 7.2$  pg/ml at the end of pregnancy (Table 1). Meanwhile, the high serum progesterone level in the estrus phase was maintained during the first four weeks of pregnancy and then showed a progressive drop in the last four weeks to a mean of  $10.6 \pm 3.2$  ng/ml just before parturition (Table 1). These hormonal levels during pregnancy were similar to our laboratory values and to those recorded by other investigators [16-18].

The female dogs wearing cotton, wool or polyester/cotton mix garments showed serum reproductive hormone levels similar to the controls with no significant differences ( $p > 0.05$ ). Pregnancy was completed

Table 2. — Serum estradiol 17 B and progesterone before and after pregnancy in the two bitches wearing pure polyester garments and which aborted four and five weeks after pregnancy.

	Estradiol (pg/ml)		Progesterone (ng/ml)	
	1 <sup>st</sup> dog	2 <sup>nd</sup> dog	1 <sup>st</sup> dog	2 <sup>nd</sup> dog
<i>Before pregnancy</i>				
Anestrus	7 <sup>*</sup>	6.8 <sup>*</sup>	0.35 <sup>*</sup>	0.40 <sup>*</sup>
Estrus	7.6 <sup>*</sup>	7.2 <sup>*</sup>	52 <sup>*</sup>	66 <sup>*</sup>
<i>After pregnancy</i>				
1/2 month	8.3 <sup>*</sup>	9.2 <sup>*</sup>	28.4 <sup>*</sup>	34.2 <sup>*</sup>
1 month	14.3 <sup>*</sup>	13.6 <sup>*</sup>	12.5 <sup>**</sup>	26.6 <sup>*</sup>
1 1/2 months	26.5 <sup>*</sup>	24.8 <sup>*</sup>	6.7 <sup>**</sup>	18.2 <sup>*</sup>
2 months	33.6 <sup>*</sup>	32.2 <sup>*</sup>	1.3 <sup>**</sup>	6.2 <sup>*</sup>

•  $p > 0.05$ ; \*  $p < 0.05$ ; \*\*  $p < 0.01$ .

Table 3. — Serum estradiol 17 B and progesterone before and after pregnancy in the two bitches in Table 2 but without garments.

	Estradiol (pg/ml)		Progesterone (ng/ml)	
	1 <sup>st</sup> dog	2 <sup>nd</sup> dog	1 <sup>st</sup> dog	2 <sup>nd</sup> dog
<i>Before pregnancy</i>				
Anestrus	7.6 <sup>*</sup>	7.2 <sup>*</sup>	0.42 <sup>*</sup>	0.40 <sup>*</sup>
Estrus	7. <sup>*</sup>	7.5 <sup>*</sup>	56 <sup>*</sup>	57 <sup>*</sup>
<i>After pregnancy</i>				
1/2 month	8.3 <sup>*</sup>	8.8 <sup>*</sup>	55.2 <sup>*</sup>	56.6 <sup>*</sup>
1 month	17.2 <sup>*</sup>	16.4 <sup>*</sup>	56.3 <sup>*</sup>	54.3 <sup>*</sup>
1 1/2 months	30.4 <sup>*</sup>	28.8 <sup>*</sup>	38.8 <sup>*</sup>	42.2 <sup>*</sup>
2 months	36.2 <sup>*</sup>	33.4 <sup>*</sup>	11.2 <sup>*</sup>	18.4 <sup>*</sup>

•  $p > 0.05$ .

and no anomalies were encountered in the offspring. As regards the bitches wearing pure polyester garments, five of the seven showed hormonal levels similar to the controls ( $p > 0.05$ ); parturition occurred with normal offspring. The remaining two animals had spontaneous abortions four and five weeks after pregnancy. Their hormonal levels during the first month of pregnancy showed a low serum progesterone level ( $p < 0.05$  and  $p < 0.01$ ), while the serum estradiol 17 B was normal ( $p > 0.05$ ) (Table 2). These two bitches had normal hormone levels in the anestrus and estrus phases of the estrous cycle (Table 2). To ascertain their normality they were mated in the following estrous cycle and, when pregnancy occurred, were not made to wear garments during the period of pregnancy. Their hormonal levels were within the normal levels during the period of pregnancy ( $p > 0.05$ ) (Table 3). Parturition occurred and the offspring showed no abnormalities.

### Electrostatic potentials

Before applying the clothing, no EP was detected on the skin of any of the groups. The mean readings of the EP obtained from the skin areas under the textile covers are shown in Table 4. Electrostatic potentials were not detected in animals groups dressed in cotton or wool, or the controls. Polyester-wearing groups recorded EPs which were higher with the pure polyester, recording a range from 418 to 633 volt/cm<sup>2</sup> (Table 4), over the poly-

Table 4. — Measured electrostatic potentials from the textile-covered skin of the four dog groups and from the control.

	Electrostatic potentials (Volt/cm <sup>2</sup> )				
	Cotton	Wool	Polyester (100%)	Polyester/cotton	Control
1	0	0	422	208	0
2	0	0	633+	246	0
3	0	0	598	306	0
4	0	0	486	282	0
5	0	0	620+	245	0
6	0	0	442	226	0
7	0	0	418	234	0

+ The two dogs that aborted spontaneously.

ester-cotton mix showing a range from 208 to 306 volt/cm<sup>2</sup>. The two bitches that aborted spontaneously recorded the highest EP (Table 4). These results were reproducible in the individual animal.

## Discussion

All groups of bitches wearing cotton, wool or polyester/cotton mix dresses as well as five of the seven animals wearing pure polyester garments had normal serum hormone levels during pregnancy, and had normal offspring. Two dogs of the seven dressed in pure polyester showed diminished serum progesterone levels during pregnancy and aborted spontaneously, although they had exhibited normal serum hormones in the anestrus and estrus phases. The subsequent pregnancy, during which the two bitches were left undressed, was completed with normal serum hormone levels and normal offspring.

Electrostatic potentials were detected on the skin of all bitches wearing polyester-blend garments. They were higher in the pure polyester garments than in the polyester/cotton mix types. The highest EPs were recorded in the two animals that aborted. Dressing in cotton or wool during pregnancy had no effect on either the serum reproductive hormone levels or on continuation of pregnancy. No EP was generated on the skin of the bitches. However, the role of polyester clothing in pregnancy needs to be discussed.

Of the seven bitches dressed in pure polyester, the two in which abortions occurred had diminished serum progesterone during the first month of pregnancy. As continuation of pregnancy necessitates high serum progesterone levels [16-18], the spontaneous abortions in these two animals are believed to have resulted from low levels of this hormone. Yet, the cause of the diminished progesterone is unknown. The drop of progesterone only in the polyester-wearing dogs postulates a relationship. Probably the EP discharged from the polyester textile affected the ovaries or the placenta which are the main progesterone sources during pregnancy. The luteal cells in the ovaries or the progesterone-secreting cells of the placenta are inhibited by the EP generated on the dogs' skin. The hypothesis of EP playing a principal role in the genesis of abortion in the two bitches is supported by the low serum progesterone levels as well as the normal pregnancy and offspring when the polyester garment was not worn.

Inhibited reproductive function did not occur in any of the bitches dressed in polyester. The effect seems to be related to the intensity of the discharged EP since the two dogs that aborted had the highest levels of EP. Although the five remaining bitches of the group wearing pure polyester as well as the seven of the polyester-cotton mix group had EP detected on their skin, the intensity was not great enough to affect reproductive function. In a previous study, polyester wearing was used as a contraceptive method in humans [19].

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