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Asian Journal of Animal and Veterinary Advances

Academic
Journals Inc.

www.academicjournals.com

Asian Journal of Animal and Veterinary Advances 3 (1): 42-46, 2008
ISSN 1683-9919

Maternal Blood and Milk Lead Concentrations Following Exposure During Pregnancy with Emphasis to its Residues in Tissues of Aborted Foeti of Goats

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Abstract: The study was carried out on two equal (7) groups of baladi goats, the first was kept as control and the second received daily oral dose of 6.0 mg lead acetate 1 kg body weight from early stage of pregnancy till abortion occurs around 14 week of pregnancy in all exposed animals. Blood samples were collected every two weeks from pregnant animals for plasma progesterone assay. Also blood and milk samples were obtained monthly for lead residue levels. Tissues from aborted foeti including bone, muscles, kidney, liver and brain were analyzed for lead residues. Results revealed a significant decline in progesterone levels from the beginning of the 6th week of gestation until abortion occurs around the fourteen week of pregnancy. Reproductive efficiency of animals after abortion revealed low pregnancy rate percentage and increase service interval period. In addition, maternal post-aborted lead level in both blood and milk showed a significant elevation. An increase in lead concentration in different organs noticed especially for femur bone, thigh muscle, kidney and liver of aborted foeti.

Key wards: Goat, blood, milk, lead, pregnancy, aborted foeti tissues

INTRODUCTION

Lead is one of the most hazardous and cumulative environmental pollutants that introduced into the environment by humans. It affects embryonic development and functioning of reproductive system (Milnes *et al*., 2006).

Lead exposure appears to reduce fertility and increase the risks of spontaneous abortion (Bellinger, 2005). Females subjected to lead for a long period suffered from disorders deals with hormonal function (Gorbel *et al*., 2002).

High blood lead levels in animals have been reported in different localities in the world such as in India (Swarup *et al*., 2005) and Egypt (Khalaf Alla and Abd El Aal, 1999), particularly in urban localities.

Lead is a well-known reproductive toxin affecting reproduction in female animals. In rats, it was associated with delayed sexual maturity, irregular estrus and reduced numbers of corpora lutea (Iavicoli *et al*., 2006). In farm animals, it causes endometritis in ewes (Stoev *et al*., 1997) impaired fertility in cows (Buhatel *et al*., 1985; McEvoy and McCoy, 1993) as well as poor conception rate, reduced detection of heat and increased service interval in buffalo-cows (El-Tohamy *et al*., 1997).

This study aimed to clarify a more reproductive details concerning the effect of chronic exposure of goats to lead throughout gestation as well as studying some reproductive indices during post-

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abortion period. In addition, measuring of both maternal blood and milk lead concentration proving its crossing through placenta with emphasis to its residues and distribution through tissues of aborted foeti.

MATERIALS AND METHODS

Lead used was in the form of lead acetate crystalline powder having a molecular weight of 379.34 g mol^{-1} purchased from Merck (Germany) and it dissolved in distilled water for oral dosing of pregnant baladi goats reared at National Research Center, experimental farm from October until March.

Fourteen pregnant baladi goats were divided into two equal groups, the first one kept as a control and the other drenched daily with 6.0 mg lead acetate/kg body weight until abortion take place.

Blood samples were collected every two weeks for plasma progesterone radioimmunoassay. After occurrence of abortion, both milk and whole blood samples were collected monthly for three successive times for determination of lead levels according to Dwivedi *et al*. (1995) and Yee *et al*. (1994). Lead level was determined by using graphite furnace atomic absorption spectrophotometery at a wavelength of 283.7 nm.

Tissues from aborted foeti (bone, muscle, liver, kidney and brain) were analyzed for lead residues according to O'Hara *et al*. (1995).

Obtained data was computed and statistically analyzed by student t-test (Snedecor and Cochran, 1980).

RESULTS

Oral administration of lead acetate to pregnant baladi goats at a level of 6.0 mg kg^{-1} body weight abrupt pregnancy to full term causing abortion in all exposed animals around 14 weeks of pregnancy that is accompanied by placental retention in some cases. Progesterone hormone showed a significant decline in its level from the beginning of the 6th week of pregnancy until abortion occurred around the 14 week of gestation (Table 1).

Post abortion and during post partum period, pregnancy rate percentage in exposed group was 42.9%; service interval period was 100.57±10.72 days compared to 100% and 36.42±1.01 days in control group animals.

Maternal post-aborted lead level in both blood and milk showed a significant elevation (Table 2 and 3). Analyzed tissues for lead from foeti of lead exposed animals showed a highly significant ($p<0.01$) increase in aborted foeti tissues except for brain tissues (Table 4).

Table 1: Effect of oral administration of lead (6 mg kg^{-1} b.wt.) during pregnancy until abortion on progesterone level (Mean±SE, ng mL^{-1})

Weeks	Control	Exposed group
2	4.77±0.58	5.60±1.32
4	4.55±0.44	3.57±0.58
6	15.40±5.10	1.35±0.06**
8	6.63±1.50	1.22±0.30**
10	6.35±1.48	1.23±0.04**
12	7.10±1.30	1.31±0.04**
14	10.30±2.10	0.70±0.02**

*: $p<0.05$; **: $p<0.01$

Table 2: Blood lead level in goats subjected to 6.0 mg lead kg^{-1} b.wt. after abortion (µg dL^{-1})

Weeks	Control	Exposed group
Just after abortion	22.50±1.84^{a}	39.80±0.19**^{a}
After 1 month	21.80±1.54^{a}	38.00±0.16**^{b}
After 2 month	22.00±1.48^{a}	34.50±0.14**^{c}
After 3 month	21.40±1.92^{a}	31.30±0.16**^{d}
F-value	0.36	15.80**

**: $p<0.01$; Different letter(s) means significance within the group

Table 3: Milk lead level in goats subjected to 6.0 mg lead kg^{-1} b.wt. after abortion ($\mu g\ dL^{-1}$)

Weeks	Control	Exposed group
Just after abortion	2.27±0.07^{a}	3.98±0.19**^{a}
After 1 month	2.13±0.14^{a}	3.80±0.16**^{b}
After 2 month	2.33±0.11^{a}	3.45±0.14**^{c}
After 3 month	2.37±0.11^{a}	3.13±0.15**^{cd}
F-value	0.83	5.40**

*: p<0.05; **: p<0.01; Different letter(s) means significance within the group

Table 4: Concentration of lead in organ samples from aborted foeti ($\mu g\ g^{-1}$) Mean±SE

Organ	Femur	Muscle	Kidney	Liver	Brain
Control	0.525±0.10^{B}	0.123±0.01^{A}	0.260±0.001^{A}	0.232±0.05^{A}	0.167±0.04^{A}
Exposed group	2.620±0.37^{B}**	0.724±0.06^{E}**	0.398±0.02^{A}**	0.425±0.04^{A}**	0.192±0.02^{A}

Difference between mean values of group bearing different capital letter(s) means significant within the group (between different organs); **: p<0.01

DISCUSSION

Lead is a reproductive toxicant. Exposure to high concentration of lead affects fertility and reproductive success causing early embryonic mortality which increased as much as 2-3 times (Butkauskas and Sruoga, 2004).

In the present investigation, baladi goats subjected to 6.0 mg lead /kg b.wt. suffered from abortion around 14 weeks of pregnancy as well as placental retention in few cases. Exposure to high concentration of lead has been associated with a variety of adverse reproductive outcomes such as spontaneous abortion, impaired fecundity and sterility (Foster *et al*., 1996; Pace *et al*., 2005). Dearth *et al*. (2002) mentioned that gestational exposure appeared more sensitive to the effects of lead. Milnes *et al*. (2006) reported that high lead exposure causes endocrine-disruptive effects that exhibit an organizational effect on the developing embryo causing adversing effect on embryonic development. Progesterone hormone assay in exposed pregnant goats showed a steady decline in its level. Similar results were recorded by Sierra and Castiglioni (1992) in guinea pigs and by Abd El-Hameed *et al*. (1998) in goats.

Abortion may occur either as a results of crossing of lead through placenta (Neathery and Miller, 1975) reaching fetus itself or as a result of placentitis (O'Hara *et al*., 1995) causing its death.

Poor pregnancy rate and increase of service period were the more pronounced reproductive features noted on exposed animals during postpartum periods. Females subjected to chronic high dose of lead suffered from reduced fertility as chronic lead exposure causes a double sexual disorder: first disorder deals with the hormonal function, which is affected at the early stages of poisoning but rapidly corrected; second disorder deals with the genital tract affecting the ovary resulting in a reduction in fertility of females in spite of presence of normal estrus (Gorbel *et al*., 2002).

Lead acts both at the level of hypothalamus and directly at gonadal sites to disrupt reproductive physiology (Ronis *et al*., 1996). At the level of pituitary, it is thought that lead may interfere with pituitary hormone release via interaction with calcium-dependant secondary messengers systems, which mediate hormone release from secretary granules storage (Klein *et al*., 1994). At the gonads, lead accumulates in the ovary resulting in dysfunction of folliculogenesis (Taupeauet *et al*., 2003). It has been reported that exposure to lead during pregnancy resulted in reduction in hypothalamic GnRH levels in both mothers and newborn (Camoratto *et al*., 1993). Lead has a direct effect on gonadal germinal epithelium causing adverse effects on reproduction (Stoev *et al*., 1997). Moreover, lead causes a decrease in gonadal weight or even act synergistically to reduce DNA gonadal content (Corpas and Antonia, 1998).

In the present study, a significant increase in both maternal blood and milk lead throughout three months post-abortion. This result is in agreement with Koyama *et al*. (1984) in goats and with Khalaf-Allah and A bd El-Aal (1999) in sheep grazing in heavy industrized area polluted with lead. It has been reported that lead retention is greater in lactating than in non-lactating dams (Hallen *et al*., 1996).

In the present study concentration of lead showed significant increase in tissues of aborted foeti from exposed animals. This increase is mainly related to transplacental transfer (Franklin *et al*., 1997; Synder *et al*., 2000). It was reported that lead accumulates in areas of active bone formation suggesting the deposition of lead salt and subsequent binding to organic matrix (Milton *et al*., 1982).

Increased lead concentration in kidney and liver was observed in this study. It is known that kidney secretes lead by glomerular filtration. An increased urinary lead level has been correlated with elevated lead nephropathy, which is seen as intranuclear inclusion bodies in the proximal tubules of lead poisoned animals (Milton *et al*., 1982). High lead concentration in liver of aborted foeti attributed to erythropoiesis taking place in liver during gestation (Danielsson *et al*., 1983).

Lead concentration in brain tissue was lower than in other organs, which may be attributed to uptake of lead by the liver firstly and reduction of blood flow to brain of fetus (O'Hara *et al*., 1995). In addition, restriction of lead uptake by the brain may take place due to blood brain barrier (Crowe and Morgan, 1996).

We can concluded that there is a relationship between exposure of pregnant goats to lead and abortion, high blood and milk lead concentration and adverse effects on reproduction post-abortion periods. It is recommended to build animal farms far away from industrialized areas and high ways.

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