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RECTAL TEMPERATURE DYNAMIC IN BULGARIAN WHITE KIDS DURING THE FIRST DAY OF POSTNATAL LIFE

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Abstract

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Rectal temperature (RT) dynamic was studied in newborn Bulgarian White kids. RT was recorded at birth, ½ h, 1 h, 3 h, 12 h, and 24 h postpartum. RT at birth had similar values in male, female, single and twin kids and was 39.59°C, 39.67°C, 39.63°C, and 39.64°C respectively. Considerable reduction ($P<0.001$) was observed in all groups of kids by ½ h of birth. During the next ½ h of life there was a further RT decrease in singleton ($P>0.05$) and increase to different extent in male ($P>0.05$), female ($P<0.05$) and twin ($P<0.05$) kids. A negligible elevation ($P>0.05$) was observed in all groups of kids between 1 and 3 h after delivery. During the period between 3 h and 12 h postpartum a drop of RT was established in male ($P<0.01$), female ($P<0.001$), twin ($P<0.001$), and single kids ($P>0.05$). From 12 h onwards male, female and twin kids showed a significant ($P<0.01$) increase in RT, whereas in singleton it was the greatest but insignificant. At 24 h of birth RT in all groups of kids achieved similar values. The results suggest that newborn kids had well expressed homeothermic ability and that the type of birth rather than birth weight appeared to have more substantial effect on their thermoregulatory capacity.

Key words: kid, newborn, rectal temperature dynamic
Abbreviation: RT - rectal temperature

Introduction

The transition of the fetus from a thermally protected environment in the dam to the extra uterine life requires fast activation of all mechanisms involved in providing of the thermal homeostasis. The neonatal period is characterized with thermal instability and is considered to be the most vulnerable time in the life of a lamb (Dwyer, 2008; Piccione et al., 2007). Studies in sheep (Samson and Slee, 1981; Slee, 1981; Sykes et al., 1976) stated that thermoregulatory mechanisms were well developed in newborn lambs which are able to maintain homeothermy under a wide variety of climatic conditions. Goats are less insulated than sheep and thought to be more sensitive to cold (Wentzel et al., 1979). Mellado et al. (2000) found out an increased level of mortality in newborn kids exposed to ambient temperatures below freezing point during the first five days after delivery. Muller and McCutcheon (1991) remarked that the metabolic rate per unite live weight was significantly lower in the newborn kids and they are more susceptible to cold than newborn lambs. They also concluded that the multiple-born kids exhibit a greater sensitivity to cold than singles. But it is

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uncertain to what extent results about thermoregulation in newborn animals derived under controlled environments in a climatic chamber, may be directly applied to newborn kids under practical farm conditions. The overview of findings indicated a scarcity of information about thermal status in newborn kids in early stage of postnatal life.

The aim of the current research was to study the rectal temperature dynamics in newborn kids born indoor and to asses the effect of different factors on their homeothermic ability.

Material and Methods

The experiment was carried out at the research farm of the Institute of Mountain Stockbreeding and Agriculture in Bulgarian White goat kids. The does were kept under conventional management practice: grazing on natural pastures during summer and confined during the winter months. The housing facilities consisted of three sections: a central section for the pregnant does and two adjacent ones, separated from the central unit by doors, for does with newborn kids. Does were observed throughout the day and immediately after parturition were separated from the flock and moved to one of the adjacent section. During the confinement period goats were fed concentrate, hay, and corn silage the diet being calculated to meet the maintenance and pregnancy requirements. The delivery took place in February.

The observations were made on 71 kids born at term and clinically healthy. The mother and offspring were separated from the flock immediately after birth, and the first rectal temperature (RT) measurement, and were placed separately in two adjacent pens on à clean straw bedding. The first colostrum feeding was performed at 1 h of birth immediately after the corresponding RT recording. Later on the kids were bottle fed with fresh goat milk at regular intervals up to 24 h of the neonatal life.

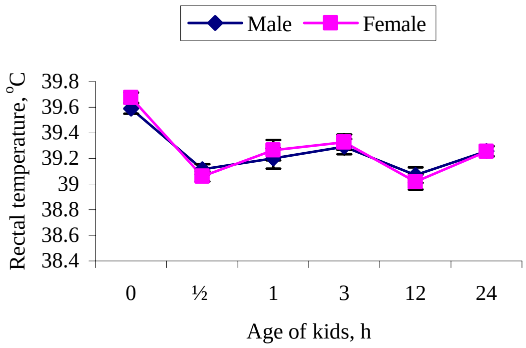
Kid weights were measured within the first hour after birth. Skin fold thickness and fleece depth were measured at the third hour after delivery on the midside with an accuracy of 0.01 and 0.1 cm respectively. Rectal temperature (RT) was recorded by digital clinical thermometer Microlife MT 16C2 (Microlife corporation, Switzerland) inserted in a depth of 6 cm at different time points after birth. The first measurements were made within a few minutes of birth, immediately after expulsion of the kid from the vulva. The second RT measurement was taken at ½ h of birth when the newborns were already located in the pens. The next measurements were performed at 1, 3, 12, and 24 h of postnatal life. Air temperatures were recorded simultaneously with RT. Environmental parameters, including air temperature, relative humidity and air velocity were monitored at various locations in the barn using thermometers, whirling psychrometer and katathermometer respectively. All environmental measurements were conducted within dam height whereas air velocity was recorded both within dam and kid height.

The results were presented as means and standard error of the mean. Statistical difference was declared at $P \leq 0.05$. ANOVA test was applied for evaluation the effects of sex, type of birth, birth weight, and sex x type of birth interaction on RT of kids at different stages of postnatal life. Data were analyzed using package software STATISTICA (2001).

Results

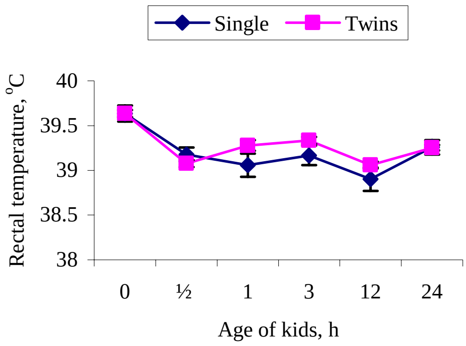
Relative humidity at different locations in the barn throughout the experiment varied between 57 and 73 %. Air velocity at different locations and heights ranged between 0.06 and 0.11 m/sec and would not be expected to influence measurably the rate of heat loss in newborn. Air temperature in the barn during the time of kidding ranged between 3.4°C and 7.2°C whereas round-the-clock deviations were negligible and rarely exceeded 3°C.

Body weight at birth, coat depth and skinfold thickness of kids, according to the sex and type of birth, are presented in Table 1. Mean birth weight of male kids was significantly higher ($P<0.001$) than that of the female ones. Mean birth weight of singleton was also significantly higher ($P<0.05$) than that recorded in twins. No detectable differences were found in



RT dynamics in male and female kids

Fig. 1. Rectal temperature dynamics in male and female kids during the first 24 h of postnatal life. Vertical bars represent SE



RT dynamics in single and twin kids

Fig. 2. Rectal temperature dynamics in single and twin kids during the first 24 h of postnatal life. Vertical bars represent SE

skinfold thickness and coat depth between kids of different sex and type of birth.

There were detectable effects of sex, type of birth, birth weight, and sex x type of birth interaction on RT of kids only at some of the age related time points studied (Table 2).

RT dynamics with advancing of the age are presented in Figures 1 and 2. The mean RT in singleton, twins, male and female lambs at birth did not differ substantially and was 39.64°C, 39.63°C, 39.59°C, and 39.67°C respectively. Time after birth had the considerable effect on RT dynamics. The mean RT irrespective of the sex and type of birth showed significant ($P<0.001$) decline during the first ½ h after delivery compared to that recorded at the time of birth. During the next ½ h, up to 1h postpartum, RT increased to different extent, compared to the previous levels, in male, female and twin kids but the difference between the two time points was significant ($P<0.05$) in female and twin kids only. RT in singleton continued to decrease ($P>0.05$) up to 1 h of extra uterine life. A negligible increase of RT ($P>0.05$), similar in all groups of kids, was observed between 1 and 3 h of postnatal life. A significant fall of RT in male ($P<0.01$), female ($P<0.001$), and twins ($P<0.001$) was recorded between 3 and 12 h after delivery being lowest and insignificant in single kids. From 12 h onwards male, female and twin kids showed a significant ($P<0.01$) increase in RT whereas in singleton it was the greatest but insignificant. At 24 h following birth the RT values recorded in male, female, single and twin kids were similar and reached 39.26, 39.26, 39.26, and 39.25°C respectively but were still well below those registered at birth. Lamb sex had no effect on RT dynamics whereas the type of birth affected the behavior of RT during the first hour of extra uterine life.

Discussion

RT of kids at birth was similar in all groups, indicating that it was mainly a function of the thermal environments in the dams. The observed RT decrease during the first ½ h after birth showed that at that time the kid cooled like a physical body as well as the lack of metabolically generated heat. Thereafter an increase in RT was observed in male, female and twin kids, whereas in singleton the decrease continued up to 1 h of birth. This may be due to the withdrawal of the placental inhibitors from the circulation and initiation of the nonshivering thermogenesis in brown adipose tissue (Ball et al., 1995; Gunn and Gluckman, 1993). Brown adipose tissue found in newborn kids (Thompson and Jenkinson, 1970) plays a major role in heat production by uncoupling ATP synthesis (Vatnik et al., 1987; Asakura, 2004) in the early postnatal life. The initiation and magnitude of thermoregulatory response depend, along with other external and internal fac-

Table 1
Birth weight (kg), coat depth and skinfold thickness (mm) according to the sex and type of birth of the kids

	Type of birth		Sex	
	Single	Twins	Male	Female
Number	12	59	39	32
Birth weight	3.71 ± 0.15^{a}	3.36 ± 0.06^{b}	3.60 ± 0.09^{c}	3.21 ± 0.08^{d}
Coat depth	13.8 ± 0.42	13.8 ± 0.15	13.8 ± 0.16	13.8 ± 0.24
Skinfold thickness	3.14 ± 0.13	3.07 ± 0.04	3.15 ± 0.06	3.05 ± 0.05

[a b] Means with different superscript differ ($P < 0.05$)
[c d] Means with different superscript differ ($P < 0.001$)

Table 2
Effects of sex, type of birth, birth weight, and sex x type of birth interaction on RT of kids at different time of postnatal life

Factor	Age of kids, hours						
	df	0	1/2	1	3	12	24
Sex	1	.172	.825	.426	.271	.174	.773
Type of birth	1	.894	.320	.215	.142	.579	.826
Sex x TB	1	.469	.437	.476	.317	.322	.484
Birth weight	1	.725	.271	.879	.460	.388	.552
R squared	70	.029	.054	.044	.056	.036	.014

tors, on the peripheral thermal inputs causing sympathetic stimulation of brown adipose tissue (Clark and Symonds, 1998; Gunn, et al., 1995; Symonds et al., 1995). Involvement of different homeothermic mechanisms may account for the differences in RT behavior in single kids compared to twins. Singleton cooled slowly than twins that may reflect partly the effect of body weight, since similar RT pattern was observed in heavier male compared to female kids up to ½ h of birth. The reduction of RT in single kids up to 1h of birth could indicate variations of the degree of physiological maturation at birth in single and twin kids and their ability to activate heat producing and/or heat preserving mechanisms which ultimately influence the body heat content. Thermoregulatory strategies used by single kids to maintain homeothermy appeared to be predominantly insulative rather than metabolic. Furthermore, the cold stimuli may have not exceeded a certain threshold level for cold receptor activation and driving an adequate type and level of responses accompanied by a metabolic overshoot and RT increase. In this study smaller kids would not be disadvantaged, with respect to the rate of heat loss, compared to larger ones because lying on dry straw bedding altered the thermoregulatory effective surface area. The latter, together with low air velocity, may explain the relatively small decrease in RT of newborn kids compared to the lambs born in the field (Faurie et al., 2004). The observed increase in RT up to 3 h of birth could be linked to both thermo effect of food and the increased endocrine activity aimed at a further enhancement of nonshivering thermogenesis in brown adipose tissue. Eales and Small (1981) established an increase of 46 % in heat production following injection of colostrum. Differential thermoregulatory response was observed in colostrums fed and colostrum deprived lambs within 1 h after birth (Hamadeh et al., 2000). This period also coincides with the commencement of vasomotor function and improving of peripheral insulation.

Reduction in RT between 3 h and 12 h postpartum was observed in all groups of kids. It may be due to a reduction of heat generation for body temperature maintenance that ultimately affected RT. Such a decrease in metabolic rate was evidently aimed at energy conservation. The observed RT fluctuations may indicate either that the thermoregulatory set point was not specified yet by the central nervous system or the thermoregulatory mechanisms were not mature enough to maintain RT values within the already fixed set point. Likewise, this drop of RT may be considered as an adaptive response aimed at energy retention. Identical patterns of RT dynamic were established in a previous study in newborn lambs of different breeds during the first day after delivery (Aleksiev et al., 2007). This similarity in RT behavior in the newborn of the two species strongly supports the concept of genetic control of the homeothermy development in newborn. The recovery of RT towards to the prepartum level was observed in all groups of kids between 12 and 24 h postpartum. The results indicated both an effective overall insulation and fully activation of adaptive mechanisms recruited in the maintenance of homeothermy.

Kid sex had no detectable effect on RT dynamics despite the significant sex differences in kid birth weight. These results are in accordance with those obtained by Muller and McCutcheon (1991). They similarly stated no effect of sex on cold resistance in newborn kids although males in their study had higher live weight than females. It is known that surface area to mass ratio is related to the rate of heat exchange. Our results corresponded to the conclusion of Sykes et al. (1976) that birth weight has measurable effect on body temperature maintenance only when heat losses approach the capacity for maximal heat production. Indeed, the heavier twins had slightly lower RT at 1 and 3 h after delivery compared to female kids. It could be presumed that they mobilized shivering thermogenesis to a less extent than did the kids with lower birth weight as well as the insufficiency of cold stimuli to cause a metabolic over reaction and RT increase. Despite the significant sex differences in birth weights male and female kids had similar RT values at all controlled time points of the study.

Conclusion

The results showed that stated changes of RT during the first 24 h of postnatal life were age related rather than with environmental and other factors. The observed changes in RT reflected the rate of heat loss, thermoregulatory capacity at birth, the sequence and the extent of recruitment of different mechanisms, providing the maintenance of the homeothermy during this early stage of postnatal life. RT values in singleton at most of the controlled points were lower than in twin, male, and female kids. Type of birth rather than birth weight itself appeared to affect more substantially the homeostatic capacity in newborn. Under the conditions of this study the newborn kids exhibited well developed homoeothermic ability and were able, despite the observed deviations, to maintain RT within the physiological limits.

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