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Relation between erythrocyte parameters and stillbirth in piglets

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ABSTRACT

The aim of this study was to investigate the relation between erythrocyte parameters of piglets and their mortality during parturition. Erythrocyte count, haematocrit volume, blood haemoglobin concentration, mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were determined in 80 live-born and 109 stillborn piglets. In both live-born and stillborn piglets the investigated parameters were evaluated with respect to sex and birth mass. Blood samples of all piglets were collected immediately after birth. Stillborn piglets had lower erythrocyte values ($P<0.01$), haemoglobin ($P<0.05$) and haematocrit ($P<0.01$) than live-born piglets. The results suggest that the incidence of stillbirth in piglets is associated with reduced levels of erythrocytes and haemoglobin in their blood. There are no significant influences of sex and birth mass on any of the investigated erythrocyte parameters in either live-born or stillborn piglets.

Key words: erythrocyte parameters, parturition, live-born piglets, stillborn piglets

Introduction

Piglet mortality remains a problem for pig production despite improved technology and management. Currently, in the EU one out of six piglets is stillborn or does not survive to weaning at about 3-5 weeks of age (DIVIDICH, 2002). Researches demonstrate that many sows and piglet variables are related to the incidence of stillbirth as well as to the early mortality rate of live-born piglets (RANDALL, 1972; DYCK and SWIESTRA, 1987; ZALESKI and HACKER, 1993; WALDMANN, 1995; FRAMSTAD and ODEGAARD, 2002; GRANDINSON, 2003). However, the relation between erythrocyte parameters and stillbirth in piglets has not been thoroughly investigated, although anaemia of piglets in early postnatal life and the preventive effect of iron treatment are well known (KAY et al., 1980; HOLTER et al.,

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1991; LEMACHER and BOSTEDT, 1994; SVETINA et al., 1994; EGELI and FRAMSTAD, 1998; KEGLEY et al., 2002; SZABO and BILKEI, 2002). The amount of haemoglobin in apparently healthy, resting newborn piglets is sometimes insufficient to transport enough oxygen to tissues (HAALAND et al., 1996).

In this work we studied the blood characteristics of live-born and stillborn piglets at parturition. The number of erythrocytes, haematocrit volume, blood haemoglobin concentration, mean cell volume (MCV) and mean cell haemoglobin concentration (MCHC) were determined. These parameters have been evaluated with respect to sex and birth mass in both live-born and stillborn piglets.

Materials and methods

Investigations were carried out on 80 live newborn piglets (42 males and 38 females) and 109 stillborn piglets (57 males and 52 females). Of live-born piglets 29 had a body mass of up to 1000 g and 51 over 1000 g, and of stillborn piglets 43 had a body mass of up to 1000 g and 66 over 1000 g. The piglets were derived from 40 sows of second and third litters. The sows were moved into individual farrowing crates one week before parturition. They were fed twice daily with commercial diets and had access to water ad libitum. Two days before parturition the quantity of food per meal was reduced. All sows were clinically healthy.

Blood samples from piglets were collected into tubes containing ethylene diamine tetraacetic acid (EDTA) as an anticoagulant. The samples were collected in each litter from all stillborn piglets and from two live-born piglets with birth order contiguous to stillborn piglets. A stillborn piglet was defined as one that made no attempts at respiration. Blood samples of all piglets were collected immediately after birth. The samples of live-born piglets were taken from the cranial vena cava, and by cardiac punction of stillborn piglets. All parameters were determined using automated blood analyser (Serono 9120 Baker System). During blood sample collection the sex and body mass of each piglet were recorded with the aim of a latter evaluation of the obtained results with respect to sex and birth body mass. Values of all examined parameters are expressed as means. Student's t-test was applied for evaluating statistical significant differences between means of both live-born and stillborn piglets. Values $P<0.05$ were considered significant.

Results

The erythrocyte parameters of live-born and stillborn piglets are presented in Figures 1 and 2. Mean values of each parameter in the investigated live-born piglets (n = 80) have been compared to those in stillborn piglets (n = 109). The average number of erythrocytes in live-born piglets was 4.74×10^{12}/L, haemoglobin concentration 101 g/L and haematocrit

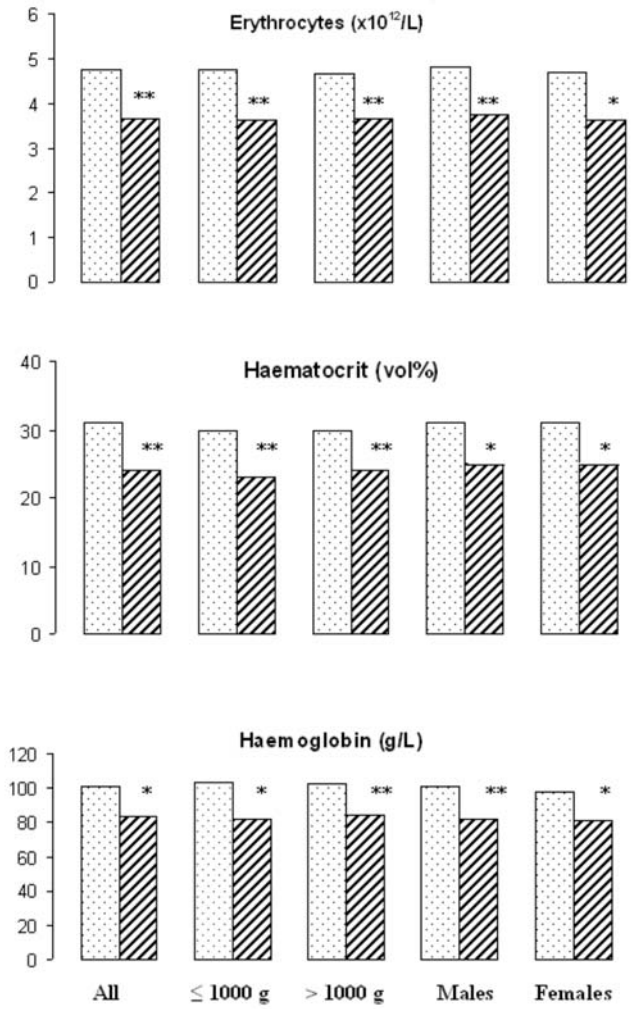

Fig. 1. Erythrocyte count, haematocrit volume and haemoglobin concentration of alive and stillborn piglets at parturition. Asterisks indicate statistical differences: *P<0.01; **P<0.05 from the respective alive piglets.

volume 31%. Compared values in stillborn piglets were 3.66×10^{12}/L, 83 g/L and 24 vol%, respectively. The statistical analyses reveal that stillborn piglets had significantly reduced erythrocyte count (P<0.01), haemoglobin concentration (P<0.01) and haematocrit volume.

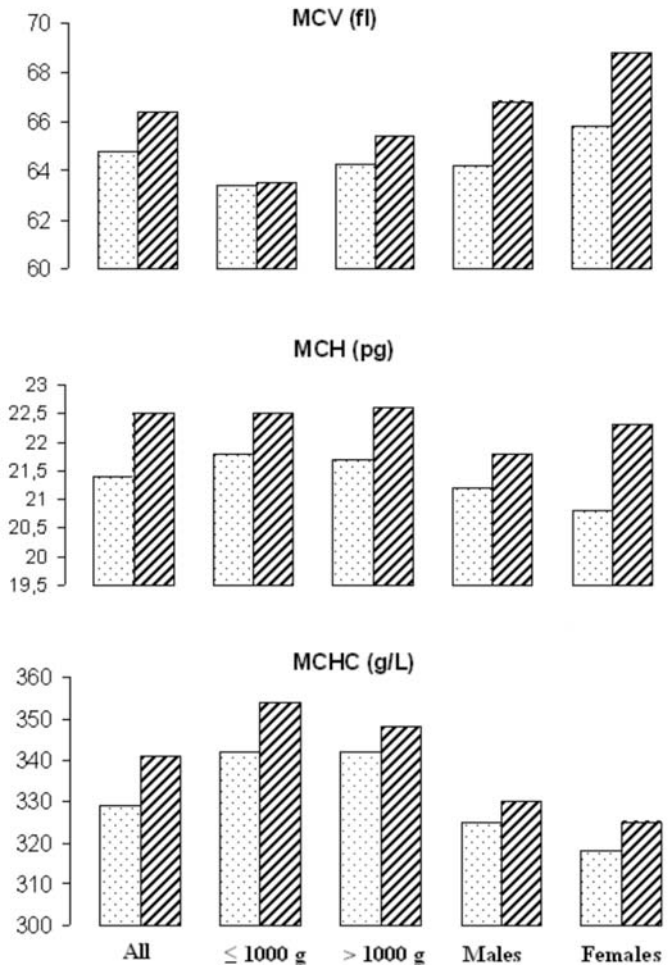

Fig. 2. Mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) of alive and stillborn piglets at parturition

However, the value of MCHC was insignificantly higher in stillborn piglets (341 g/L) than in live-born piglets (329 g/L).

After the distribution of piglets had been done according to body mass (up 1000 g and over 1000 g) and sex, significant differences were also evident between live-born and stillborn animals in erythrocyte count, haemoglobin concentration and haematocrit volume.

However, there were no significant differences in any of the investigated parameters between live-born piglets weighing up to 1000 g and over 1000 g, as well as between stillborn piglets weighing up to 1000 g and those having greater mass. Also, we found no significant differences in any of the haematological values between live-born male and female piglets, or between stillborn males and females. Thus, the results represented in Figures 1 and 2 generally indicate that the haematology of both live-born and stillborn piglets in our investigations was not influenced by their body mass and sex.

Discussion

We found significantly reduced erythrocyte counts and haemoglobin concentrations in stillborn piglets. The mean haemoglobin concentration of 83 g/L measured in these piglets cannot be considered to indicate a severe anaemia, according to previous findings in healthy newborn piglets (FURUGOURI, 1975; VAN KEMPEN, 1987; HOLTER et al., 1991). However, comparison of haematological parameters in live-born and stillborn piglets does suggest that erythrocyte number and haemoglobin concentration could be associated with the survival of piglets during parturition. SVENDSEN et al. (1991) also found a lower concentration of haemoglobin in stillborn than in live-born piglets. Further, FAGENHOLZ et al. (1979) found that the presence of anaemia in foetal pigs increases the risk of asphyxiation at birth. ZALESKI and HACKER (1993) reported that the probability of stillbirth increases with reduced haemoglobin in piglets, although the influence of sow's haemoglobin to the probability of stillbirth was not significant in their investigations.

We found no significant difference in any of the investigated erythrocyte parameters between live-born male and female piglets, or between stillborn male and female piglets. Further, the distribution of live-born and stillborn piglets according to body birth mass indicates that there are no significant differences in haematology of piglets weighing up to 1000 g and over 1000 g. We can therefore conclude that the haematological values of both live-born and stillborn piglets are not markedly influenced by their body birth mass and sex. Also, no difference in the death incidence during parturition between our male and female piglets was observed.

It is generally accepted that iron-deficient anaemia is characterised by microcytic hypochromic erythrocytes. However, in our results there are no significant differences between live-born and stillborn piglets in erythrocyte size and their haemoglobinisation. Since the blood picture in piglets at birth is determined by immature erythrocytes, which are larger than the mature cells (JAIN, 1986), it is possible that they mask microcytosis in mild anaemia. But MCHC values were even higher in stillborn piglets than in piglets born alive. This indicates that iron deficiency does not seem to be the only reason for lower total haemoglobin in the blood of stillborn piglets.

In conclusion, the main feature of this work is the demonstration that stillbirth in piglets is associated with reduction of erythrocyte and haemoglobin levels. On the basis of such findings, we could suppose that asphyxia, which results in the death of foetuses, is caused, at least in part, by insufficient oxygen supply. The results suggest the possibility of improving survival rate of piglets during delivery through the nutritional treatment of pregnant sows, which results in increased erythrocyte production and haemoglobin synthesis in piglets.

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SAŽETAK

Cilj rada bio je ustanoviti postoje li razlike između živorođene (n = 80) i mrtvorođene prasadi (n = 109) u broju eritrocita, količini hemoglobina, volumenu hematokrita, zatim prosječnom volumenu eritrocita (MCV), prosječnoj količini hemoglobina u eritrocitu (MCH) i prosječnoj koncentraciji hemoglobina u eritrocitu (MCHC). Na temelju usporedbe rezultata dobivenih u živorođene i mrtvorođene prasadi procjenjivana je povezanost eritrocitnih pokazatelja sa smrtnošću u tijeku porođaja. Mrtvorođena prasad imala je manji ($P<0,01$) broj eritrocita, te manju ($P<0,05$) količinu ukupnog hemoglobina u krvi i postotak hematokrita ($P<0,01$) od živorođene prasadi. Stoga ti rezultati upućuju da je pojava mrtvorođenja u prasadi povezana sa smanjenom količinom eritrocita i hemoglobina u njihovoj krvi. Ne postoji značajniji utjecaj spola i težine prasadi na bilo koji od istraživanih krvnih pokazatelja, kako u živorođene tako i u mrtvorođene prasadi.

Ključne riječi: eritrocitni pokazatelji, porođaj, živorođena prasad, mrtvorođena prasad