INSULIN GROWTH FACTOR 1 IN WEANLING-GROWING PIGS

ONTOGENY OF SERUM INSULIN-LIKE GROWTH FACTOR-I IN PIGS FROM BIRTH TO 65 DAYS OF AGE

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Summary

Insulin-like growth factor-I (IGF-I) is a 70 amino acid, single chain polypeptide hormone and an important regulator of cell growth and differentiation. Most fetal and adult tissues synthesize IGF-I although the liver is the major source of IGF-I found in the circulation. During fetal life circulating IGF-I levels are low, however, after birth, concentrations gradually increase. Considerable evidence supports a primary role for IGF-I in regulation of postnatal growth.

Most IGF-I occurring in plasma and other body fluids is bound to one of 6 identified IGF binding proteins (IGFBP). These binding proteins prolong the half life of IGF-I in plasma and may either potentiate or inhibit IGF-I effects on body tissues. The concentration of individual IGFBPs in body fluids therefore has a significant impact on the biological activity of circulating IGF-I.

Plasma concentration of IGF-I is mediated by a complex interaction among nutrient quantity and quality as well as other factors such as stress and disease. These factors are also likely to influence the circulating concentration of IGFBP. Knowledge of the changes in blood levels of IGF-I and IGFBP under current swine management conditions may provide a basis to determine the impact of various management practices on piglet growth and welfare.

Objectives

• To examine the relationship between the levels of circulating IGF-I and body weight gain.

• To determine the effects of parity of the dam (gilt vs. sow) and sex of piglet (male vs. female) on serum IGF-I concentration.

Material and Methods

Animals:

One male and one female piglet (close to the mean litter weight) was selected from each of 8 gilt and 8 sow litters. Piglets were offered creep feed at 7 days and were weaned at 3 weeks of age. After weaning, piglets were fed a phase I diet for 10 days followed by a phase I (50%) + phase II (50%) for a further 10 days. The phase II diet was fed until the piglets reached approximately 17 Kg of body weight. After this time, piglets were moved from nursery to finishing room and fed a phase III diet. Phase I, II, and III diets were purchased from Federated Co-op.

Experimental:

Blood samples were obtained by jugular vein puncture at 2, 4, 8, 14, 20, 21, 22, 23, 25, 28, 31, 32, 33, 34, 36, 41, 42, 43, 44, 46, 52, 59, 60, 61, 62 and 64 days of age. Reduced sampling intervals coincided with weaning and diet changes. Blood samples were allowed to clot at room temperature for 2-3 hours before serum was separated and stored at -20 C until assayed by radioimmunoassay for IGF-I.

All the piglets were weighted regular interval 7 days.

Statistical analysis:

Differences between group sex and parity were determined by two -way analysis of variance (ANOVA). Correlation between IGF-I level and weight gain was assessed by linear regression analysis.
Results and Discussion

Serum IGF-I level was low at birth and increased gradually with age (Figure 1). IGF-I level was 2.5-3.5 fold higher at 3 weeks age than that of birth. For reasons which are unclear, IGF-I levels in female piglets were significantly (P<0.05) higher than in males during the suckling phase and the phase I + II feeding period. No significant difference in IGF-I level was observed between piglets from sows and gilts. Weaning resulted in a dramatic decline in serum IGF-I. IGF-I concentration remained low for approximately 10 postweaning days during feeding of the phase I diet and gradually increased when the diet was switched from phase I to phase I + II. Circulating IGF-I levels did not recover to preweaning values until approximately 3 weeks after weaning. A second marked decline in IGF-I concentration occurred when the diet was switched from phase II to phase III. Similar to the situation at weaning, the shift from the phase II to the phase III diet was accompanied by additional stresses including moving from the nursery to the growth area and mixing of penmates.

Variation in serum concentration of IGF-I is commonly associated with variation in body weight. The data of this study confirms that IGF-I level is highly correlated with growth rate. A strong positive correlation (r=0.84, P<0.01) was observed between serum IGF-I and body weight. Fig 2 illustrates that IGF-I concentration roughly paralleled the increase body weight.

At 3 weeks of age the suckling piglet remains almost completely dependent on the sow or gilt for nutrition. Although capable of extracting nutrients from highly digestible milk the gastrointestinal tract of the 21d old pig is immature and poorly equipped to deal with solid plant based diets. The immune system of 21d old pig is similarly immature. Antibodies and other factors present in sow or gilt milk are receiving increased attention for their protective effect against enteric disease in the neonates.

Accordingly, weaning represents a significant insult to the baby pig. Physiological limitations to growth including a digestive tract unsuited to the diet and increase susceptibility to disease are compounded by the social stress of mixing littermates and removal from the dam.

The physiological and social stresses of weaning were reflected in the current study in a persistent and dramatic decline in circulating IGF-I. Analysis of circulating IGF-I levels therefore seems to represent a very sensitive measure of weaning stress. Future investigation will utilize circulating IGF-I as a measure of the impact of various management and nutritional approaches to weaning on piglet performance and welfare.