PELVIC MEASUREMENT AS AN AID TO SELECTION IN BEEF CATTLE

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SUMMARY

Pelvic measurements were taken in industry based beef cattle seedstock herds and used for genetic parameter estimation. Regression coefficients for age and correlations with hip height and weight at time of measurement were calculated and are presented. While the relationship of pelvic size to calving ease is not calculated, variation in pelvic size independent of height and weight is reported, suggesting that there may be scope for change in the relative size of the pelvic opening. Heritabilities of pelvic measures are high and correlations between sexes are high and positive. The estimates were consistent across breed and sex. The technique used to collect pelvic measurements appears suitable for use in an industry based selection program.

INTRODUCTION

Feoto pelvic disproportion has been described as the main reason for calving difficulty (Meijering 1984) and pelvic size will have a major effect on the foeto pelvic ratio. Increasing pelvic size without a consequential and proportional increase in calf size is the challenge. There is scope for improving pelvic size via selection of both males and females. However if pelvic size is a minor component of the prediction of calving ease as some researchers have found (Rice and Wiltbank 1972), pelvic measures will need to be highly heritable to make a significant change in the level of calving difficulty. The correlation between pelvic size and other traits of influence, such as birth weight and growth rate, will also need to be favourable before calving ease will respond to selection for pelvic size.

Pelvic size is positively correlated to birthweight (Koots et al. 1994), hence selection for pelvic size will indirectly increase birthweight. The magnitude of the correlation between pelvic size and birthweight is critical to the ultimate effect of selection for pelvic size and birthweight on calving ease per se, if we accept that calving ease is made up of two components; direct calving ease and maternal calving ease. Pelvic area has been related to calving difficulty in beef cattle for many years (Bellows et al. 1971) but little work has been reported on genetic parameters, and therefore the potential of this measurement to genetically improve the calving ease of beef heifers. In addition, few studies have used data collected from industry based herds.

This paper reports some results of a three year study in beef cattle seedstock herds which included pelvic measurements. Six different breeds were represented in the study including herds from South Australia, Victoria and New South Wales.

MATERIAL AND METHODS

Herds participating in this study were part of a larger MRC funded project known as the Validation Project. To be involved in this project herds needed to have a minimum of eighty recorded breeding females, be part of a GROUP BREEDPLAN, be committed to BREEDPLAN recording and have a management system capable of undertaking the data collection exercise. Pelvic measurements were taken by contracted field officers who also collected hip height, scrotal size and ultrasound scan measurements for eye muscle area and fat depth, at the same time recording feet, leg and udder scores.

Pelvic dimensions were measured using a rice pelvimeter inserted in the rectum. Pelvic area was calculated by multiplication of height and width. The officers operating the pelvimeter were trained and tested for repeatability. Both males and females were measured at either 400 or 600 days of age. Full pedigree was available. Liveweight and hip height were measured on animals within 14 days of the date of pelvic measurement.

Preliminary analysis of results was conducted using SAS GLM procedures to identify important effects to be included in the model for analysis. Estimates of genetic parameters were obtained using DFREML (Meyer 1992). At 400 days the model of analysis included age (linear) and age of dam (linear and quadratic) covariables plus contemporary group. For the analysis at 600 days, age of dam was included where significant.

RESULTS

Pelvic data for this study was 17,442 individual measurements representing over 1500 sires of six breeds in 68 herds. There were few repeat measurements taken between 400 and 600 days as, in general, animals were only measured at one age. Pelvic height, width and area, shown in Table 1 are remarkably similar at each age for the six breeds involved. Males on average had smaller pelvic size than females at the same age even though they were always heavier (mean weight difference for the breeds ranged from 71.3 to 114.0 kg) and taller (mean height differences ranged from 4.1 to 9.7 cm). Females had 0.49 to 0.71 cm greater pelvic height and 0.23 to 0.62 cm extra width.

Table 1. Mean age, pelvic measures, liveweight and hip height for heifers from six breeds measured at around 400 or 600 days

(Age) Breed	Number	Mean Age (days)	Pelvic Height (cm)	Pelvic Width (cm)	Pelvic Area (cm^2)	Live weight (kg)	Hip Height (cm)
400 days							
A	2302	416	14.7	12.2	179.8	294.7	115.8
H	1780	418	14.5	12.1	176.0	298.2	117.1
P H	1846	416	14.5	12.2	177.9	300.7	116.7
M G	420	435	14.3	12.1	173.2	294.3	116.3
Sh	443	426	14.7	12.9	191.4	302.7	119.7
Si	390	425	15.3	13.6	208.2	368.9	128.5
600 days							
A	820	593	16.4	13.8	226.2	396.5	122.9
H	830	572	15.9	13.6	216.9	371.5	123.1
P H	486	587	16.4	13.5	229.5	409.2	124.3
M G	348	591	15.8	13.5	213.5	398.1	120.7
Sh	97	561	16.3	14.5	236.8	417.8	127.1
Si	442	582	16.5	14.8	244.6	451.9	132.5

A - Angus; H - Hereford; P H - Poll Hereford; M G - Murray Grey; Sh - Shorthorn; Si - Simmental

Heritabilities for the six breeds (Table 2) estimated at 400 days for all traits, were medium to high. The estimates of heritability for the different breeds were relatively homogeneous, therefore pooled estimates are presented for heritabilities and genetic correlations.

Table 2. Heritabilities (SE) and genetic correlations for pelvic height, width and area pooled across breeds when measured at 400 days

		Heritabilities			Genetic Correlations		
Trait	**Females**	**Males**	**Both**	**PWdth**	**PArea**	**Live Wt**	**Hip Ht**
PHght	0.35 (.04)	0.37 (.05)	0.34 (.03)	0.58 (.04)	0.87 (.02)	0.61 (.04)	0.71 (.02)
PWdth	0.41 (.04)	0.46 (.05)	0.41 (.03)		0.91 (.02)	0.51 (.04)	0.53 (.03)
PArea	0.43 (.04)	0.48 (.05)	0.42 (.03)			0.61 (.02)	0.68 (.02)
Live Wt	0.47 (.07)	0.40 (.05)	0.44 (.03)				0.77 (.01)
Hip Ht	0.65 (.04)	0.71 (.05)	0.66 (.03)				

Heritabilities at 600 days for males and females were slightly higher than, and genetic correlations similar to, those calculated at 400 days. However the heritability calculated from combined sexes was lower.

The genetic correlation between males and females for pelvic area measured at 400 days ranged from 0.79 to 1.00 across the breeds. Pelvic height and width ranged from 0.61 to 1.00 and 0.65 to 1.00 respectively, while weight and hip height had a smaller range from 0.83 to 1.00 and 0.81 to 1.00 respectively. Genetic correlations between the sexes at 600 days tended to be lower, especially for pelvic height which could imply prior selection for height at this age in males.

Age at measurement had a significant influence on pelvic size of both heifers and males. Across breed the range of regression coefficients of pelvic area on age at 400 days was 0.29 to 0.33 cm^2 per day for heifers. For males the range was 0.21 to 0.25 cm^2 per day. Crow and Indetie (1994) reported a regression coefficient for bulls of 0.22 cm^2 per day. At 600 days the regression coefficient for age was lower in all sexes and breeds, the range for heifers being 0.20 to 0.22 cm^2 per day. Age of dam was a significant factor in the prediction equation for pelvic size in all sexes and breeds, although the increase in r^2 of the model value was small.

DISCUSSION

Pelvic measurement is a cheap and easy measurement which can be taken on both sexes, and pelvic measures taken under relatively controlled field conditions have moderate to high heritability. Heritability estimates for pelvic area at 600 days tended to be larger in both sexes than the estimate at 400 days. The implication is that you may be better to delay selection on pelvic size until the later age, but there is some concern that there could be a degree of selection already occurring if we take note of the considerably lower heritability of the combined sexes at 600 versus 400 day. The heritabilities for weight calculated in this data set were also slightly higher than currently used in BREEDPLAN, which may indicate that the data collection was conducted under considerably greater control than normal. The heritability estimates for weight in this data set are similar to those published by Mohiuddin (1993) in his review of the subject. Contemporary groups were recorded by the field officers at the time of taking pelvic measurements and this may have increased the accuracy. The heritabilities for pelvic dimensions calculated from this data support the suitability of the technique used for field measurement of pelvic size.

To be useful as a selection criterion for increasing calving ease, the heritability of pelvic measurement must be high and genetic correlations with other traits of interest favourable, or if antagonistic, low enough to be manageable in a selection program. Genetic correlations between males and females for pelvic measurements were high and in some cases approaching unity, which indicates that selection of sires on pelvic size will increase the pelvic size of his daughters, resulting in a favourable effect on maternal calving ease. The positive genetic correlation between pelvic area and weight (and the known positive correlation between weight and birthweight) would imply that birthweight will increase with selection for pelvic area, which is an unfavourable relationship with respect to direct calving ease. As selection for pelvic area has a more direct effect on maternal calving ease than birthweight, it might be expected that the net effect of selection for calving ease is positive.

Crow and Indetie (1994) estimated genetic correlations between EPDs for pelvic area and maternal calving ease EPDs to be not significantly different to zero. They concluded that 'pelvic dimensions of yearling beef bulls has little value as an indicator trait for calving ease either as expressed by their daughters or by their daughters calves'. They do admit however that the accuracies of the calving ease EPDs were low and this may play a role in the small correlations. Pelvic areas in their study were measured after bulls had been in test stations for 140 days and no consideration was given to herd of origin or pre-selection in the calculation of the contemporary comparison of pelvic area. Results from the Validation project show that for all breeds and sexes the age of dam effect is significant at least at 400 days, so it is reasonable to assume that other preweaning effects may also carry over.

Attempts were made to estimate the correlation between pelvic area and calving ease by calculating the correlations between EBVs, direct and maternal, and pelvic area. However only a few bulls for which we had pelvic measures also had calving ease EBVs, and these were of relatively low accuracy. The Validation project, at this stage, has not collected sufficient data on calving ease to conclusively answer the question on the net effect of selection for pelvic size. Calving ease data for heifers measured will continue to be submitted for the next twelve months, and young bulls that have been measured will have calving ease data on their daughters for years to come. This may provide the information needed to analyse the relationship between pelvic measurement and calving ease.

CONCLUSIONS

Pelvic measurement is heritable and the correlation between measurement in males and females is strongly positive, indicating that selection in either sex will genetically increase pelvic size. However, the relative importance of pelvic measurement won't be ascertained until the value of pelvic size through its relationship with calving ease is established. Correlations of pelvic area with weight and hip height are high, with age and age of dam having a significant effect on pelvic size. Hence, for comparison, pelvic measures must be examined within a contemporary group with appropriate corrections for age, and age of dam if possible. If pelvic measurement is to be used in BREEDPLAN, an estimate of the genetic correlation between pelvic area and calving ease is necessary. This will only be achieved if more calving ease information is submitted.

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