

# PRELIMINARY DATA COMPARING EMBRYO TRANSFER EFFICIENCY OF SIMMENTAL HALF-SISTER DONORS: NORMAL VS 14/20 CENTRIC FUSION CARRIER

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## INTRODUCTION

The effect of the 1/29 centric fusion (CF, Robertsonian translocation) anomaly is quite well known. Swedish researchers<sup>1</sup> first reported a 7% reduction in fertility in Swedish Red and White cattle based on non-return rates of cows bred to heterozygous positive (carrier) bulls. A study<sup>2</sup> of the reproductive efficiency of beef cattle carrying this cytogenetic anomaly vs. that of normal (non-carrier) beef animals showed that the carrier bulls had a 0.52 greater insemination/pregnancy index. Carrier daughters of affected bulls had a calving-to-conception interval that was 18.5 days longer than that of daughters of normal bulls. Similar results were obtained in a study in Brazil<sup>3</sup>. Schmutz et al<sup>4</sup> studied the chromosomes of 39 seven day-old embryos collected from nine 1/29 CF carrier cows and 38 cows with normal karyotypes bred to normal and 1/29 CF carrier bulls. In each case the matings were between a normal and 1/29 CF carrier bulls. The 39 embryos were from 374 fertilized ova obtained from 86 successful collections where all chromosomes of isolated embryo cells could be identified. They found that 8 of the 39 embryos (20.5%) would

have died in utero because their cells contained unbalanced karyotypes (unequal, lethal distribution of chromosomes, i.e., monosomies and trisomies). It was concluded that the major loss in reproductive potential of the 1/29 CF carrier cows or bulls appeared to be due to early embryonic death rather than fertilization failure. However, there are no published data regarding the effect of CF translocations on bovine embryo transfer (ET) efficiency.

Since the 14/20 CF was found in the Simmental breed in the US two years ago, our laboratory has received more than 400 blood samples from concerned Simmental cattle breeders. Among these animals one of a pair of half-sister donor cows for ET was diagnosed a 14/20 CF carrier and the other a non-carrier. This paper presents preliminary data comparing embryo transfer efficiency of the two Simmental half-sister donors: Normal vs 14/20 CF carrier.

## MATERIALS AND METHODS

Data were collected from two polled purebred Simmental cows. They are half-sisters because their sire is the same. Their age and body condition also are similar. Cow A is a 14/20 CF carrier, while cow B is not. The two animals were simultaneously

selected as donors for ET in 1985. They were superovulated at approximately 60- to 210-day intervals, up to eleven (animal A) and ten (animal B) times respectively over 6 years, 1985-1990. The standard procedure for superovulation was applied with minor changes. Embryos were recovered 7 days after breeding by nonsurgical embryo collection technique and were evaluated as to the total number, number fertilized, number of transferable quality, and number of calves. The latter category was further divided into two subgroups: calves from transferring fresh vs. frozen embryos. The t-test and X<sup>2</sup>-test were used for statistical analysis.

### RESULTS

A total of 303 ova or embryos were obtained from the two Simmental half-sister donors. Collections from the 14/20 CF carrier yielded fewer ova or embryos on average than collections from the non-carrier (Table 1) but the difference was not statistically significant (P > 0.05).

TABLE 1  
MEAN NUMBER OF OVA AND EMBRYOS  
PER COLLECTION FROM TWO  
SIMMENTAL  
HALF-SISTER DONORS

Cow	14/20 Carrier	Non- Carrier
Mean	13.2 ± 6.6	15.8 ± 6.3
Range	5-25	6-27

Although the fertilization rates seemed different between the two animals as seen in Table 2, no statistical significance was found (P > 0.05). However, the non-carrier cow had a higher percentage (65.8%) of

transferable embryos as compared to the 14/20 CF half-sister (52.4%, P < 0.05).

TABLE 2  
FERTILIZATION RATE AND EMBRYO  
QUALITY FROM TWO SIMMENTAL  
HALF-SISTER DONORS

Cow	14/20 Carrier	Non- Carrier
Collections	11	10
Total	145	158
Number of fertilized eggs	100 (69.0%)	124 (78.5%)
Number of transferable embryos	76 (52.4%)	104 (65.8%)*

\*Significant difference, P < 0.05

TABLE 3  
CALVING RATE OF EMBRYOS FROM TWO  
SIMMENTAL HALF-SISTER DONORS

Cow	14/20 Carrier	Non- Carrier
No. fresh ET Calves	61 42 (68.9%)	49 28 (57.1%)
No. Frozen ET Calves	15 10 (66.7%)	53 18 (34.0%)*
Total ET	76	102
Total calves	52 (68.4%)	46 (45.1%)

\*Significant difference, P < 0.05

The calving rate of these transferable embryos from the two half-sister donors is summarized in Table 3. Freshly transferred embryos from the non-carrier half-sister resulted in live calves in 28 of 49 (57.1%) transfers as compared to 42 of 61 (68.9%) for the 14/20 CF carrier. However, there was

no significant difference in calving rate between the two animals ( $P > 0.05$ ). On the other hand transfer of previously frozen embryos from the non-carrier half-sister produced in live calves in 18 of 53 (34.0%) transfers as compared to 10 of 15 (66.7%) for the 14/20 CF carrier ( $P < 0.05$ ).

### DISCUSSION

The possible effect of the 14/20 CF condition on ET efficiency has been of concern in the ET industry since this chromosomal defect was reported in the Simmental breed in the United States<sup>5</sup>. Previous studies involving embryos from the 1/29 CF carrier showed that four theoretical segregation products result during meiosis, and the rate of unbalanced embryos ranged from 3.8% to 20% due to diversified analysis procedures<sup>4</sup>. However, the real effects of the CF on ET efficiency cannot be predicted on the basis of these data because of limited samples. On the other hand, conduction of such field experiments investigating this issue will be very costly and practically not feasible. The data presented in this article were obtained from the two half-sister donors with the similar criteria such as genetic background, age, raised area, superovulation procedure, collections of embryos, ET operating company as well as technical personals. Therefore, these data might reasonably be assumed to come from an experiment designed carefully.

The 14/20 CF half-sister did not yield fewer ova per collection, on average, than did the non-carrier (Table 1,  $P > 0.05$ ). This lack of effect of the CF condition to impair the female responsiveness to superovulation differs from the results of Schmutz et al observed<sup>4</sup>. The data on proportion

of ova fertilized (Table 2) suggest that the 14/20 CF half-sister had no more difficulty producing fertilized ova than did the non-carrier. Thus our results suggest that sperm and ova with chromosomal defects are capable of participating in zygote formation (fertilization). The more remarkable finding is that the non-carrier had a higher percentage of transferable embryos (65.8%) as compared to the 14/20 CF half-sister (52.4%;  $P < 0.05$ ; Table 2). The difference of 13.4% in transferable embryos between the two animals may be due to embryonic degeneration resulting from the aneuploid gametes of the CF half-sister donor. It is quite well known that many factors can effect bovine frozen embryos. Although the calving rate of transferring frozen embryos from the 14/20 CF half-sister was much higher (66.7%) than that from the non-carrier (34.0%;  $P < 0.05$ ; Table 3), the calving rates of transferring fresh embryos were similar in the two donors (Table 3). This indicates that there were other factors rather than CF to have caused a higher percentage of pregnancies resulted from use of frozen embryos from the 14/20 half-sister versus the non-carrier.

Based on the above, we tentatively conclude that the 14/20 CF may effect ET efficiency through reducing number of transferable embryos.

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#### SUMMARY

There are no published data regarding the effect of a 14/20 centric fusion (CF) translocation on bovine embryo transfer (ET) efficiency. In a preliminary study, data from 303 ova or embryos from two Simmental half-sister donors, one a heterozygous carrier for the 14/20 CF and the other normal, were analyzed. The average numbers of ova and embryos collected from the normal (15.8) vs the 14/20 CF carrier (13.2) were similar ( $P > 0.05$ ). Also similar was the proportion of ova fertilized between the normal and the 14/20 CF carrier half-sister: 78.5% vs 69.0%, respectively ( $P > 0.05$ ). However the normal cow had a higher percentage of transferable embryos (65.8%) as compared to the 14/20 CF half-sister (52.4%;  $P < 0.05$ ). Freshly transferred embryos from

the normal half-sister resulted in live calves in 28 of 49 (57.1%) transfers as compared to 42 of 61 (68.9%) for the 14/20 CF carrier. On the other hand transfer of previously frozen embryos from the normal half-sister resulted in live calves in 18 of 53 (34.0%) transfers as compared to 10 of 15 (66.7%) for the 14/20 CF carrier. The findings of a difference of 13.4% (65.8% vs 52.4%) in transferable embryos between the normal and the 14/20 CF half-sister may be due to embryonic degeneration which might result from the aneuploid gametes of the donor. A higher percentage of pregnancies resulted from use of frozen embryos from a 14/20 CF carrier versus a normal animal was not associated with the CF. It is tentatively concluded that the 14/20 CF may effect ET efficiency through reducing number of transferable embryos.

#### ZUSAMMENFASSUNG

Die Wirkung des 14/20 Robertsonischen Translokation (Centric Fusion, CF) ist auf die Liestungsfähigkeit bei Übertragung den Embryos von Rindern erforsched. Zur Verwendung waren 303 Eizellen und Embryos, die aus zwei Halbschwestern der Rasse Simmental erzielt waren. Der einer war heterozygous Positiv, der andere war Normal. Durchschnittlich sind die Ergebnisse beiden Kühe gleich an Eizellen und Embryos erzielt: bei der 14/20 CF positive Kuh - 15.8; bei der normale Kuh - 13.2 ( $P > 0.05$ ). Auch auf beider Kühe war die Fruchtbarkeit prozentisch gleich: normale Kuh - 78.5%; 14/20 CF positive Kuh - 69.9% ( $P > 0.05$ ). Jedoch bei Übertragbarkeit den Embryos hat Ergebnisse der normale Kuh über die 14/20 CF positive Kuh Vorteil: 65.0% bzw. 52.4% ( $P <$

0.05). Bei Anwendung Embryos die frisch übertragen waren, hat Ergebnisse der 14/20 CF positive Kuh gegen die normale Kuh Vorteil: 42/61 (68.9%) bzw. 28/49 (57.1%). Im Gegenteil, bei Anwendung gefrorene Embryos hat Ergebnisse die 14/20 CF positive Kuh gegen die normale Kuh Vorteil: 10/15 (66.7%) bzw. 18/53 (34.0%). Die Ursache dieser Uneinigkeiten sind diskutiert. Wir vermuten dass bei Vorhandesein der 14/20 CF Anomalie ist die Leistungsfähigkeit bei Übertragung den Embryos von Rindern vermindert.

### RESUMEN

Fueron analizados datos de 303 huevos o embriones de 2 donadoras medias hermanas Simmental, una de ellas portadora heterocigotica de la fusión céntrica (FC) 14/20 y la otra normal. Los numeros promedio de huevos y embriones colectados del animal normal (15.8) comparado con la portadora FC 14/20 (13.2) fueron similares ( $P > 0.05$ ). La proporción de huevos fertilizados del animal normal y la portadora media hermana FC 14/20: 78.5% y 69.0% respectivamente fueron también similares ( $P > 0.05$ ). Sin embargo, la vaca normal tuvo un porcentaje mayor de embriones transferibles (65.8%) comparada la media hermana portadora del FC 14/20 (52.4%;  $P < 0.05$ ). Los embriones transferidos frescos de la media hermana normal resultaron en 28 becerros vivos de 49 transferencias (57.1%) comparadas con 42 de 61 (68.9%) de la portadora FC 14/20. Por otro lado la transferencia de embriones congelados de la media hermana normal resultaron en 18 becerras vivas de 53 transferencias (34.0%) comparadas con 10 de 15 (66.7%) de la portadora FC 14/20. Los

hallazgos de una diferencia de 13.4% (65.8% contra 52.4%) de embriones transferibles entre las medias hermanas normal y FC 14/20 puede ser debida a una degeneración embrionica que podría resultar de los gametos aneuploides de la donadora. El porcentaje mas elevado de preñez que resultado del uso de embriones congelados de la portadora FC 14/20 comparado con la donadora normal, no fue asociado con la FC. Se concluye tentativamente que la FC 14/20 puede afectar la eficiencia de la transferencia de embriones reduciendo el numero de embriones transferibles.