Journal of Reproduction and Development, Vol. 66, No 4, 2020

Opinions and Hypotheses

Transfer of a single embryo versus drainage of subordinate follicles to prevent twin pregnancies in dairy cows. Why not both?

Fernando LÓPEZ-GATIUS[1, 2] and Irina GARCIA-ISPIERTO[2, 3]

[1)]*Transfer in Bovine Reproduction SLu, 22300 Barbastro, Spain*
[2)]*Agrotecnio Centre; University of Lleida, 25198 Lleida, Spain*
[3)]*Department of Animal Science, University of Lleida, 25198 Lleida, Spain*

Abstract. In this study, we present two proposed approaches to prevent twin pregnancies in dairy cattle: 1) single, *in vitro*-produced embryonic transfer into a recipient cow or 2) subordinate follicle drainage at the time of insemination. Both procedures lead to improved embryonic survival. As the use of sexed semen generates herd replacements and additional heifers, we propose the transfer of a single female cattle embryo into cows that are not suitable for producing replacements, and follicular drainage in lactating cows with genetic merit. This should eliminate economic losses associated with twin pregnancies and increase cattle output of the herd.
Key words: Double ovulation, Follicular co-dominance, Corpus luteum (CL) function, Early fetal loss, Greenhouse gas emissions

(**J. Reprod. Dev. 66:** 287–289, 2020)

The problem of twin pregnancies in dairy herds

Twinning rates in dairy herds have increased considerably in parallel with milk production during the last 30 years [1], possibly due to a higher double ovulation rate being associated with a high level of milk production [2, 3]. Twin pregnancies, more frequent in older cows, may account for 25% of all pregnancies on Day 60 of gestation in cows in their third lactation or more [4], and are classified into bilateral (one fetus in each uterine horn: 44%) and unilateral (both fetuses in the same uterine horn, right or left: 56%) [5]. Twin pregnancy is not desirable for the dairy cattle economy [5–9]. The risk of pregnancy loss during the first trimester of gestation for twin-carrying cows is three to seven times higher than that for cows carrying singletons [1], with an economic burden estimated at $ 97–$ 225 per pregnancy depending on twin pregnancy laterality (unilateral *vs*. bilateral), parity, and the days in milk when the twin pregnancy occurs [6]. This impact could become even greater due to the incidence of abortion among pregnant cows during the second or third trimester of gestation. In an extensive study on 1194 twin pregnancies, abortion was recorded in 278 (23.3%) cows before Day 260 of pregnancy: 7/522 (1.3%) in bilateral and 271/672 (40.3%) in unilateral pregnancies [5]. In this latter study, the presence of live twins was determined by transrectal ultrasonography between 55 and 61 days of gestation. Furthermore, losses after twin delivery in cows reaching parturition should be added to the economic impact of twin pregnancies. Higher incidence of peripartum reproductive disorders, freemartins, stillbirths, and calf mortality has been related to twin births [7–9]. Thus, both a higher culling rate and reduced mean production lifespan (by 200 days) have been reported for cows delivering twins versus singletons [7–9]. These are all cogent reasons to try to reduce the incidence of twin births. Proposed approaches to prevent twin pregnancies are 1) the transfer of a single embryo to a non-inseminated cow or 2) the follicular drainage of subordinate follicles at the time of insemination [10].

Transfer of a single *in vitro*-produced embryo

Fertility rates for *in vitro*-produced (IVP) bovine embryos are lower than those achieved with *in vivo*-derived embryos [11]. However, the global use of IVP embryos has increased over the past twenty years, probably due to the increasing benefits and lower costs of IVP procedures [10]. Effectively, embryo transfer (ET) is considered the most effective mechanism for maximizing fertility during heat stress, improving fresh IVP embryo pregnancy results comparable to artificial insemination (AI) under heat stress conditions [12]. Treatment with GnRH on Day 5 post-estrus increases the corpus luteum (CL) blood flow area, thus improving luteal function assessed on Day 7 at ET [13] and prompting additional corpora lutea formation [14]. This treatment improves embryonic survival in IVP embryo recipients [14].

Received: January 30, 2020
Accepted: March 25, 2020
Advanced Epub: April 7, 2020

Correspondence: F. López-Gatius (e-mail lopezgatiusf@gmail.com)

Puncture and drainage of subordinate follicles at the time of insemination

Puncture and drainage without suction of subordinate follicles —either ultrasound-guided [15, 16] or by using a simple transvaginal device [17]— at the time of insemination has proved efficient to eliminate the risk of twin pregnancy without reducing fertility. Only bi-ovular cows with a size difference of less than 2 mm between the two follicles were included in these studies [15–17]. This technique increases the incidence of additional drained follicle-derived corpora lutea. The function of the drainage-induced CL was improved with GnRH treatment on Day 7 post-drainage [16, 17]. This treatment improved embryonic survival in drained cows [17]. It should be noted here that an ultrasound-guided training before follicular puncture should be considered by inseminators. Furthermore, a potential problem related to the technique is the fact that the smaller follicle is not always the subordinate follicle at the time of insemination. More extensive studies are thus needed that take into account the ranges between the dominant and drained subordinate follicle diameter.

The use of sexed semen helps twin prevention strategies

The use of sexed semen has been traditionally recommended only for heifers [18, 19], as pregnancy rates are reduced in cows [20, 21]. Although its usage is low (< 5%) within the AI market [22], it generates herd replacements and additional heifers [23]. Sexed sperm have been successfully used in *in vitro* fertilization procedures [24, 25] so that embryos of a desired sex may be transferred.

Concluding remarks

In herds where sexed semen is used in heifers thus providing sufficient herd replacements, the strategies proposed to prevent twin pregnancies could increase herd profitability in a number of ways:

– By conducting both, the embryo transfer of a single cattle embryo to cows that are not suitable for producing replacements and the follicular drainage in lactating cows with genetic merit, the economic losses associated with twin pregnancies should be prevented.

– Following both procedures, induced additional corpora lutea [14, 17] will reduce the risk of pregnancy loss [26].

– Use of female cattle embryos or sexed semen, should reduce the incidence of male calf-related dystocia, improving animal health. Gestation of a female calf has also been related to increased milk production [27, 28].

– Introducing ET into the breeding program should improve the fertility of older cows under heat stress conditions [12].

– Compared with the use of conventional semen, sexed semen used in heifers and follicular drained parous cows should expedite herd expansion and increase the sale value of calves.

– While increasing cattle output from a dairy herd, greenhouse gas emissions will be lower compared with beef cow herds, and land use will be more efficient [23].

Acknowledgments

The authors thank Ana Burton for assistance with the English translation. This study received financial support from procedure “01.02.01 de Transferència Tecnològica del Programa de desenvolupament rural de Catalunya 2014-2020” (Number 19005).

References

1. **López-Gatius F, Andreu-Vázquez C, Mur-Novales R, Cabrera VE, Hunter RHF.** The dilemma of twin pregnancies in dairy cattle. A review of practical prospects. *Livest Sci* 2017; **197**: 12–16. [CrossRef]
2. **Fricke PM, Wiltbank MC.** Effect of milk production on the incidence of double ovulation in dairy cows. *Theriogenology* 1999; **52**: 1133–1143. [Medline] [CrossRef]
3. **López-Gatius F, López-Béjar M, Fenech M, Hunter RHF.** Ovulation failure and double ovulation in dairy cattle: risk factors and effects. *Theriogenology* 2005; **63**: 1298–1307. [Medline] [CrossRef]
4. **Garcia-Ispierto I, López-Gatius F.** The effects of a single or double GnRH dose on pregnancy survival in high producing dairy cows carrying singletons or twins. *J Reprod Dev* 2018; **64**: 523–527. [Medline] [CrossRef]
5. **Garcia-Ispierto I, López-Gatius F.** Abortion in dairy cattle with advanced twin pregnancies: Incidence and timing. *Reprod Domest Anim* 2019; **54**(Suppl 4): 50–53. [Medline] [CrossRef]
6. **Mur-Novales R, López-Gatius F, Fricke PM, Cabrera VE.** An economic evaluation of management strategies to mitigate the negative effect of twinning in dairy herds. *J Dairy Sci* 2018; **101**: 8335–8349. [Medline] [CrossRef]
7. **Nielen M, Schukken YH, Scholl DT, Wilbrink HJ, Brand A.** Twinning in dairy cattle: A study of risk factors and effects. *Theriogenology* 1989; **32**: 845–862. [Medline] [CrossRef]
8. **Bicalho RC, Cheong SH, Galvão KN, Warnick LD, Guard CL.** Effect of twin birth calvings on milk production, reproductive performance, and survival of lactating cows. *J Am Vet Med Assoc* 2007; **231**: 1390–1397. [Medline] [CrossRef]
9. **Andreu-Vázquez C, Garcia-Ispierto I, Ganau S, Fricke PM, López-Gatius F.** Effects of twinning on the subsequent reproductive performance and productive lifespan of high-producing dairy cows. *Theriogenology* 2012; **78**: 2061–2070. [Medline] [CrossRef]
10. **López-Gatius F, Hunter RHF.** Preventing twin pregnancies in dairy cattle, turning the odds into reality. *Livest Sci* 2019; **229**: 1–3. [CrossRef]
11. **Sartori R, Prata AB, Figueiredo ACS, Sanches BV, Pontes GCS, Viana JHM, Pontes JH, Vasconcelos JLM, Pereira MHC, Dode MAN, Monteiro PLJ Jr, Baruselli PS.** Update and overview on assisted reproductive technologies (ARTs) in Brazil. *Anim Reprod* 2016; **13**: 300–312. [CrossRef]
12. **Hansen PJ.** Reproductive physiology of the heat-stressed dairy cow: implications for fertility and assisted reproduction. *Anim Reprod* 2019; **16**: 497–507. [CrossRef]
13. **Kanazawa T, Seki M, Ishiyama K, Araseki M, Izaike Y, Takahashi T.** Administration of gonadotropin-releasing hormone agonist on Day 5 increases luteal blood flow and improves pregnancy prediction accuracy on Day 14 in recipient Holstein cows. *J Reprod Dev* 2017; **63**: 389–399. [Medline] [CrossRef]
14. **García-Guerra A, Sala RV, Carrenho-Sala L, Baez GM, Motta JCL, Fosado M, Moreno JF, Wiltbank MC.** Postovulatory treatment with GnRH on day 5 reduces pregnancy loss in recipients receiving an in vitro produced expanded blastocyst. *Theriogenology* 2020; **141**: 202–210. [Medline] [CrossRef]
15. **López-Gatius F, Hunter R.** Puncture and drainage of the subordinate follicles at timed artificial insemination prevents the risk of twin pregnancy in dairy cows. *Reprod Domest Anim* 2018; **53**: 213–216. [Medline] [CrossRef]
16. **López-Gatius F, Garcia-Ispierto I, Serrano-Pérez B, Balogh OG, Gábor G, Hunter RHF.** Luteal activity following follicular drainage of subordinate follicles for twin pregnancy prevention in bi-ovular dairy cows. *Res Vet Sci* 2019; **124**: 439–443. [Medline] [CrossRef]
17. **Garcia-Ispierto I, López-Gatius F.** Improved embryo survival following follicular drainage of subordinate follicles for twin pregnancy prevention in bi-ovular dairy cows. *J Reprod Dev* 2020; **66**: 93–96. [Medline] [CrossRef]
18. **Seidel GE Jr, Schenk JL, Herickhoff LA, Doyle SP, Brink Z, Green RD, Cran DG.** Insemination of heifers with sexed sperm. *Theriogenology* 1999; **52**: 1407–1420. [Medline] [CrossRef]
19. **Newton JE, Hayes BJ, Pryce JE.** The cost-benefit of genomic testing of heifers and using sexed semen in pasture-based dairy herds. *J Dairy Sci* 2018; **101**: 6159–6173. [Medline] [CrossRef]
20. **DeJarnette JM, Nebel RL, Marshall CE, Moreno JF, McCleary CR, Lenz RW.** Effect of sex-sorted sperm dosage on conception rates in Holstein heifers and lactating cows. *J Dairy Sci* 2008; **91**: 1778–1785. [Medline] [CrossRef]
21. **DeJarnette JM, Nebel RL, Marshall CE.** Evaluating the success of sex-sorted semen in US dairy herds from on farm records. *Theriogenology* 2009; **71**: 49–58. [Medline] [CrossRef]
22. **Seidel GE Jr.** Update on sexed semen technology in cattle. *Animal* 2014; **8**(Suppl 1): 160–164. [Medline] [CrossRef]
23. **Holden SA, Butler ST.** Review: Applications and benefits of sexed semen in dairy and beef herds. *Animal* 2018; **12**(s1): s97–s103. [Medline] [CrossRef]

24. **Lu KH, Cran DG, Seidel GE Jr.** In vitro fertilization with flow-cytometrically-sorted bovine sperm. *Theriogenology* 1999; **52**: 1393–1405. [Medline] [CrossRef]
25. **Hamano K, Li X, Qian XQ, Funauchi K, Furudate M, Minato Y.** Gender preselection in cattle with intracytoplasmically injected, flow cytometrically sorted sperm heads. *Biol Reprod* 1999; **60**: 1194–1197. [Medline] [CrossRef]
26. **López-Gatius F.** Factors of a noninfectious nature affecting fertility after artificial insemination in lactating dairy cows. A review. *Theriogenology* 2012; **77**: 1029–1041. [Medline] [CrossRef]
27. **Hinde K, Carpenter AJ, Clay JS, Bradford BJ.** Holsteins favor heifers, not bulls: biased milk production programmed during pregnancy as a function of fetal sex. *PLoS One* 2014; **9**: e86169. [Medline] [CrossRef]
28. **Hess MK, Hess AS, Garrick DJ.** The effect of calf gender on milk production in seasonal calving cows and its impact on genetic evaluations. *PLoS One* 2016; **11**: e0151236. [Medline] [CrossRef]