ADAPTATION OF BACTRIAN CAMEL TO HOT DESERT CLIMATE USING INTERSPECIES EMBRYO TRANSFER

A. Niasari-Naslaji1, M. Barani2, H.R. Adel3, A. Ghanbari4 and A.A. Moosavi-Movahedi5

1Department of Theriogenology, Faculty of Veterinary Medicine, 2Centre of Excellence in Biothermodynamics, University of Tehran, Iran
2Veterinary Organisation of Qom Province, 3Jihad-e-Agriculture Organisation of Semnan province, 4Research Centre For Agriculture and Natural Resources of Ardabil Province, Ministry of Jihad-e-Agriculture, Iran

ABSTRACT

Bactrian camel in Iran is adapted to the cold environment and can’t tolerate hot desert climate. We hypothesised that the uterus of dromedary camel acclimatised to hot region, could provide the condition for bactrian camel embryo to be able to adapt to hot climate postnatal. Bactrian camel donors were superovulated according to the standard procedure. Embryos were recovered non-surgically on day 8.5 after inducing ovulation. Recipient dromedary camels were induced to ovulate when they had a mature follicle, 13–17 mm in diameter, on the ovary. Grade one bactrian camel embryos were transferred non-surgically to recipients when they were on Day 6.5-7.5 after inducing ovulation. Since 2008, when the first bactrian camel calf was born, totally 15 calves (6 males and 9 females) were born. Ten calves were born in the cold environment and 6 calves were born in the hot desert climate. At the moment, all progenies have 4-6 years of age without any particular problem. In conclusion, the adaptation to different climate could be transferred via the uterus to embryo. This novel finding will provide the opportunity to extend an endangered Iranian bactrian camel, which adapted to the cold environment, to hot desert climates.

Key words: Adaptation, bactrian camel, embryo transfer

Bactrian camel population in Iran is acclimatised to the cold environment and can’t tolerate hot desert climate. This species in Iran is threatened with extinction; although, it is assumed that it was domesticated on the eastern border of the Caspian sea around 2500 BC, and from there it was migrated to several countries worldwide (Niasari-Naslaji, 2008). Unfortunately due to the several factors including changes in transportation, domination of dromedary camel and inability of Iranian bactrian camel to acclimatise to hot and arid environment, the population of this species in Iran decreased to about 150 heads.

The intrauterine conditions in which the mammalian foetus develops have an important role in regulating the function of its physiological systems later in life (Fowden et al, 2006). Intrauterine programming of physiological systems occurs at the gene, cell, tissue, organ, and system levels and may cause permanent structural and functional changes leading to either postnatal abnormalities in cardiovascular, metabolic, and endocrine function in rats, guinea pig, sheep, pigs, horses, and primates (Fowden et al, 2005, 2006; McMillen and Robinson, 2005) or physiological adaptations (Gluckman et al, 2005; Fowden et al, 2006; Hanson and Gluckman, 2005). The objective of this study was to investigate the possibility of exploiting uterine environment for inducing embryo adaptation to the climate, different from its origin.

Materials and Methods

Bactrian camels (donors; n=5) and dromedary camels (recipients; n=15), in the cold environment, belonged to the Bactrian Camel Breeding Centre, Meshginshahr, Ardabil Province, Iran (latitude: 38° 23′ N; longitude:47° 40' E; altitude: 1568.5m; temperature range: -15 - 20°C; annual rain fall: 361 mm). Dromedary camels (recipients; n=20), in the hot desert environment, were provided by Camel Breeding Centre for North and North-West of Iran, Toroud, Semnan Province, Iran (latitude: 35° 25′ N; longitude: 55° 0′ E; altitude: 885 m; temperature range: -3 - 51 °C; annual rain fall: 90 mm).
Multiple ovulation and embryo transfer programme

The bactrian camel donors were superovulated according to the procedures described previously (Nikjou et al, 2008). In brief, GnRH agonist, Alarelin (25 µg; Vetaroline, Aburaihan, Iran) was used to induce ovulation of mature follicle (13-17 mm). Two days later, FSH was injected at decreasing doses (60, 40, 30, 30, 20 mg, i.m.; Foltropin-V; Bioniche, London, ON, Canada) twice daily for 5 days, followed by a single injection of 20 mg, i.m., FSH on day 6 (total FSH 380 mg). Prostaglandin F2α analogue was injected on day 5 of superovulation. Daily ovarian ultrasonography was performed until most of the growing follicles had reached a size of 10-17 mm. At this time, the donor camel was mated twice, 24 h apart, to a fertile male bactrian camel and given an i.m. injection of GnRH agonist at the time of the first mating (Moghiseh et al, 2008). Embryos were recovered 8.5 days after the first mating.

Recipient dromedary camels were synchronised using two injections of GnRH agonist, 14 days apart (Nikjou et al, 2008; Nikjou and Niasari-Naslaji, 2010). Ovulation was induced when mature follicle, 13-17 mm in diameter, was detected. Embryo transfer was performed 6.5-7.5 days after GnRH injection.

Embryo recovery was conducted non-surgically, 8.5 days after the first mating using a silicone two-way Foley catheter (~64 cm, 20 Fr; AB Technology, Dresher, PA, USA) and a total volume of 2 L Ringer’s solution (Daru Pakhsh Pharmaceutical Company, Tehran, Iran) containing 0.2% bovine serum albumin (BSA; Sigma, St Louis, MO, USA). Recovered embryos were transferred into holding medium (ZA454; IMV Technologies, L’Aigle, France) and were washed four times with holding media before morphological evaluation under a stereomicroscope (Olympus SZX12; Olympus, Tokyo, Japan). Embryos were graded from 1 to 5; Grade 1, excellent; Grade 2, good; Grade 3, poor; Grade 4, collapsed and degenerated; Grade 5, fragmented and degenerated. For embryo transfer, only Grade 1 embryos were loaded into 0.25-ml straws (IMV) and transferred non-surgically, through recto-vaginal approach, into the uterine horn of the dromedary camel recipients using a bovine/equine embryo transfer gun (IMV). Pregnancy was diagnosed 25 days after embryo transfer using ultrasonography.

Results

On average 6 transferable embryos from each donor bactrian camels were recovered. Out of 35 embryo transfers 16 pregnancy were achieved. There was one stillbirth (male calf) in hot climate environment. Since 2008, when the first male bactrian camel calf was born from interspecies embryo transfer (Niasari-Naslaji et al, 2009), another 14 calves (5 males and 9 females) were born. Nine calves were born at the Bactrian Camel Research Centre, 6 calves were born at Camel Breeding Centre. At the moment, they are healthy and between 4-6 years of age without any particular problems.

Discussion

The working hypothesis of this study was to investigate the antenatal maternal effect (uterine environment) on the adaptation ability of embryo to different climate postnatal. Accordingly, the objective of the present study was to extend bactrian camel, acclimatised to the cold environment, to the hot desert climates using interspecies embryo transfer. Dromedary camel has proven to be a good recipient for bactrian camel embryo. Dromedary camels have good mothering ability and produce sufficient milk to maintain Bactrian camel calves in good condition. Using interspecies embryo transfer, we have demonstrated for the first time that Bactrian camel calves, born from dromedary camels in the hot environment, in which the temperature can rise up to 51°C, can tolerate hot environment. This novel finding will allow to extend Iranian Bactrian camel, which adapted to the cold environment, to hot desert climate.

Genetic-by-environment interaction could result in phenotypic variation of particular species (Falconer, 1981; Bernardo, 1996). Environment variations experienced by genetically identical individuals may produce different phenotypes, so called as phenotypic plasticity (Stearns, 1992). During the last two decades, it was documented that uterine environment could provide the prerequisite for expression of several diseases and behavioral disorders (Baker, 1998; Rutter et al, 2001; Thaper et al, 2007). The presence of any detrimental factors within uterus throughout the growth of the embryo may cause structural and/or metabolic changes affecting the subsequent health of newborn (Baker, 1998). The incidence of schizophrenia in the child whose mother had malnutrition is proven (Neugebauer, 2005). Antenatal stress/anxiety, associated with continuous exposure of embryo to glucocorticoids, could result in behavioral/emotional disturbance in the child (Glover and O’Conner, 2002). Moreover, mothers with diabetes...
(Csorba and Edwards, 1995; Sattar, 2004) and nutritional deficiency contribute to the occurrence of cardiovascular diseases in the offspring (Roseboom et al, 2000). In contrast, transfer of mouse embryos with diabetes origin to the mother who did not have any history of genetic basis for diabetes prevents the occurrence of diabetes in the newborn (Greeley et al, 2002). Several environmental mechanisms that induce the expression of particular genes followed by particular phenotype have been demonstrated (Gilbert, 2005; Fowden et al, 2006; Gagliano and McCormick, 2007). In neuro-endocrine mechanism, the neurons detect the environmental stimuli and provide the signals for production of specific hormones that may induce the expression of particular genes. Gene methylation is another mechanism in which the gene does not express due to the presence of environmental factors. Finally, microbial agents that co-exist within environment may directly influence the expression of particular genes.

The working hypothesis of this study was based on the fact that the uterine environment of dromedary camels, adapted to hot environment, may induce adaptive properties for Bactrian camel embryo which did not adapt to hot desert climates. Consequently, the Bactrian calves could tolerate hot desert environment. In conclusion, the birth of Bactrian calves from dromedary mothers in hot desert climates and their growth to 6 years of age in such environment have provided the convincing document indicating that adaptation to different climate could be induced by maternal effect to the embryo.

Acknowledgements
This research was funded by the Iranian National Foundation for Science (INSF). The authors thank the director and station staff of Bactrian Research Center at Jahadabad, Meshkinshahr, Ardabil, and Camel Breeding Center for North and North-West of Iran, Toroud, Semnan, for providing facilities and kind assistance throughout the experiment.

References


