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Non-Surgical Embryo Collection (NSER) and Transfer (NSET) in Sheep and Goats

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Abstract

Non-surgical embryo recovery (NSER) and transfer (NSET) techniques represent a significant advancement in reproductive biotechnology for sheep and goats, offering less invasive, more ethical, and cost-effective alternatives to traditional surgical methods. This review explores the physiological, anatomical, and technical foundations of NSER and NSET, focusing on cervical relaxation strategies, hormonal superovulation protocols, and field-based embryo recovery outcomes. Key hormonal protocols include the use of 133 mg or 333 IU of FSH-p, and cervical relaxants such as 37.5 μg cloprostenol and 1 mg estradiol benzoate. Transcervical embryo collection success rates have reached over 60% in sheep and up to 90% in goats under optimized conditions. Embryos recovered through NSER exhibit high post-collection viability and comparable developmental potential to those obtained surgically. The adoption of NSER and NSET depends on appropriate donor selection, technician training, and standardization of protocols, supporting sustainable and welfare-conscious genetic improvement in small ruminants.

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The use of non-surgical techniques for embryo recovery (NSER) and embryo transfer (NSET) in sheep and goats has advanced significantly over the past decades as a response to the demand for less invasive, more ethical, and more field-viable procedures. From the earliest reports of embryo collection and transfer in these species, laparotomy was the standard approach, limiting its use to specialized centers. With the consolidation of NSER techniques starting in the late 1990s, particularly following the studies of and the research programs conducted by Embrapa since 2003, new horizons have emerged for the application of reproductive biotechnology in small ruminants. This review aims to explore the physiological foundations, technical advancements, and reproductive outcomes associated with non-surgical embryo recovery and transfer in sheep and goats, emphasizing aspects such as cervical relaxation, superovulation, synchronization, success rates, and future perspectives.

In Brazil, the first studies on embryo collection in sheep were conducted by Selaive and Mies Filho (1979), while in goats the earliest reports are attributed to Jaume and Bruschi (1984). Both approaches relied on laparotomy to access the uterus, only replaced by less invasive methods from the mid-1990s onwards. Fonseca (2006) reported the first transcervical embryo transfer in ewes, while Gusmão et al. refined the non-surgical embryo recovery method in Santa Inês sheep. Concurrently, Embrapa launched the SUPER-OVI projects, which aimed to standardize superovulation, cervical relaxation, and transcervical embryo recovery protocols. These projects have expanded to include multiple sheep and goat breeds and are supported by national and international agencies.

The NSER technique is based on the possibility of transcervically accessing the uterus using a specialized catheter connected to a flushing circuit, without requiring laparotomy. For this, proper cervical relaxation must be achieved through hormonal and mechanical

means. The cervical anatomy of ewes and does presents significant barriers, characterized by a tortuous canal with multiple muscular and connective rings that vary between animals and breeds. demonstrated through neural markers (PGP-9.5) that the vaginal fornix and cervix exhibit dense innervation, highlighting the importance of adequate analgesia and anesthesia to avoid pain. Most protocols use low epidural anesthesia combined with acepromazine or xylazine sedation, and involve cervical traction using specula and adapted forceps.

Success in NSER is directly related to cervical relaxation and successful transcervical access. Multiple studies have evaluated pharmacological strategies to facilitate this process. compared the administration of 37.5 μg cloprostenol (PGF2α, -12h) and 1 mg misoprostol (PGE1, -5h) in ewes superovulated with FSH. Cervical transposition success was 58.8% in the PGF2α group and 63.1% in the PGE1 group, while no success was recorded in the control group. The procedure duration ranged from 27 to 33 minutes, and uterine flushing success exceeded 95% in both treatments. The average number of viable embryos was 3.3 in the PGF2α group and 4.0 in the PGE1 group. In Dorper sheep, 1 mg of PGE1 led to 63.1% NSER success, with no transpositions in animals without prior pharmacological treatment.

Superovulation is a core component of both NSER and NSET protocols. Embrapa's standard protocol includes 133 mg or 333 IU FSH-p administered in six decreasing doses. This protocols typically results in 8 to 12 corpora lutea and up to 7 viable embryos per donor, as demonstrated by Figueira et al. (2020), Fonseca and Oliveira (2021), and Dias et al. (2021). In goats, the response is comparable, although embryo recovery rates are more dependent on cervical accessibility, which is usually greater than in sheep.

Anatomical characteristics also affect NSER success. In a recent study, 34% of failed procedures occurred in ewes with vestibulo-vaginal stenosis, 50% showed poor cervical distension, and 25% had extremely long or convoluted cervices . Pre-selection of donors using Hegar probe tests and cervical ultrasonographic mapping helps identify candidates more likely to respond positively . A history of recent lambing, easy speculum insertion, and a cervical score ≤3 are associated with higher success rates .

Regarding embryo quality, survival rates after 24 and 48 hours of in vitro culture following NSER were high, even after cryopreservation, as shown by . Prior administration of 0.5-1.0 mg estradiol benzoate, combined with 37.5 μg cloprostenol and 50 IU oxytocin, enhanced cervical relaxation and embryo survival. .

From an ethical and economic standpoint, the adoption of NSER and NSET is a significant advancement. Protocol costs vary depending on the drugs used: a single injection of 300 UI of hCG on day 4 post-device removal costs around USD 2.00 and increases progesterone levels and viable embryo yield ; reinserting a progesterone device has no additional cost, and flunixin meglumine administered over three consecutive days costs about USD 2.60, with equally promising results .

In conclusion, non-surgical embryo recovery is now an established reality with outcomes equivalent to laparotomy in terms of recovery rate and embryo quality. Its adoption in genetic improvement programs for sheep and goats depends on trained personnel, proper donor selection, strict hormonal control, and standardized protocols. The future trend is toward broader NSER and NSET application, driven by growing concern for animal welfare and the need for sustainable and economically viable reproductive solutions in modern animal production systems.

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