Electroejaculation: a welfare issue?

Semen is collected from a wide range of mammals and birds for artificial breeding, semen evaluation, semen banking and disease diagnosis. It is collected from domestic and captive animals by electroejaculation, manual stimulation of the accessory sex glands, manual stimulation of the penis, artificial vagina (AV), intravaginal condom and intravaginal collection post-coitus. Electroejaculation is particularly suited for captive species as it can be carried out in sedated or anaesthetised animals and an oestrous female is not required to stimulate ejaculation.[1] *It is regularly used on bulls and rams without sedation or anaesthesia.*

Electroejaculation involves the stimulation by electrical current of emission, erection and ejaculation.[2] Emission of semen from the ampullae and vasa deferentia into the pelvic urethra is a sympathetic response effected by contraction of smooth muscle in response to stimulation of the lumbar sympathetic nerves which form the hypogastric nerve.[2][3] In the bull these nerves terminate in the region of the ampulla and seminal vesicles.[2] Erection and ejaculation is controlled by sacral parasympathetic nerves which form the pelvic and internal pudendal nerves located at the level of the pelvic urethra and the body of the prostate gland.[2]

The intrarectal ejaculation probes used to stimulate emission, erection and ejaculation in domestic animals transmit an oscillating current of either a sine-wave or pulse-wave (square-wave) form.[4] Ram probes usually deliver pulses at 30 to 50 Hz delivered through bipolar rectal electrodes in volleys of 3 to 5 seconds followed by a similar period of rest. Such a pattern of stimulation repeated for up to a minute will produce ejaculation in most cases.[5] Most modern ram probes produce a current up to a maximum of 10 V.[5] The current produced by the probes used in bulls may be altered and electroejaculation is stimulated by starting with the probe set at the lowest voltage and gradually increasing the voltage until ejaculation occurs.[2] The stimulation should be almost continuous as allowing a respite of more than one second will affect the stimulation of erection.[2] Many modern ram and bull probes are preprogrammed to deliver a series of stimuli considered appropriate for the species.

The physical reaction of conscious animals to electroejaculation has led to some concern about the welfare of bulls, rams and male goats subjected to the procedure[4][6] and some European animal welfare organisation have suggested that it be banned.

Effects of different types of probes and stimulatory currents

The older commercial electroejaculation probes had ring electrodes[4], that is, electrodes which surround the barrel of the probe. These electrodes stimulated nerves other than those required for electroejaculation. In particular, nerves located dorsal to the rectum supplying muscles in the hind limb were stimulated, resulting in strong contractions of the muscles of the legs, thighs and back.[2][6] These contractions were severe enough with some types of probes to cause haemorrhage and bruising of affected muscles and stiffness for a few days[10] but there is no evidence of permanent damage being inflicted by electroejaculation.[11] The claim by Samantha *et al*[9] that electroejaculation caused injury in male goats is not supported convincingly by their findings.

In the bull during natural ejaculation there is generalised muscular contraction and the hind legs may be brought off the ground during this spasm.[7] In rams there is a backward head-bounce as part of the ejaculatory reflex.[8] Some of the muscular activity observed during electroejaculation may be that which occurs during natural ejaculation.

To reduce extraneous muscular effects, modern probes have longitudinal electrodes on the ventral side. These electrodes concentrate the electrical stimulation in the area where the relevant nerves are located with less stimulation of motor nerves that supply skeletal muscles.[4] This simple modification of probe design has decreased the intensity of the physical response to electrical stimulation significantly.[2] The correct placement and orientation of the probe is important.

The ejaculatory response to different electrical currents has been examined in bulls,[11] rams[6][12] and male goats[4] with mixed recommendations. In general sine-wave currents appeared to be more effective in stimulating ejaculation.[2] A low frequency sine-wave of 18 to 20 Hz supplied a long duration stimulus necessary to activate the slower unmyelinated nerve fibres of the autonomic system and appeared to be less effective in stimulating motor nerves.[4] A probe with 15 V peak voltage was less disturbing to rams with regard to bodily reaction than a probe giving a 60 V peak.[12] During electroejaculation the voltage of the electroejaculation probes should be under the control of the operator and at the start of electroejaculation it should be set at a low level and increased until ejaculation occurs.[4] Modern probes have preprogrammed current pattern starting at the lowest level and increasing gradually until ejaculation occurs at which stage the current can be stabilised. This allows for more control over the unwanted muscular reaction as at the voltage required for ejaculation there is less contraction of back and limb muscles.[4]

The pattern of stimulation may also influence the physical response to ejaculation. The physical response of rams to electroejaculation using a ring type sine-wave probe was monitored by Cameron.[6] When the electrical stimulus was applied for 3 seconds with a rest interval of 5 seconds and the voltage was increased in 0.5, 1.0 or 2.0 V increments until ejaculation occurred electroejaculation was accompanied by severe physical reactions 'with excessive muscular contractions'. The rams were difficult to restrain and there was a marked increase in the rate and depth of respiration. When the rest interval was increased to 10 seconds and the current increment was 1.0 V the physical response was greatly reduced. The usual recommendation with regard to the pattern of stimulation for rams of 4 or 5 seconds of stimulation and

4 or 5 seconds of rest[5][12] does not apparently take into account the findings of Cameron[6] and further research with regard to this aspect of electroejaculation is warranted.

Behavioural and physiological responses to electroejaculation

It could be stated with some degree of confidence that natural mating is an attractive activity for most male domestic ruminants and they will do their best to gain access to oestrous females. To determine how rewarding or aversive electroejaculation is we can monitor the reaction of animals to repeated electroejaculation using aversion tests. Aversion tests have been used on farm animals to determine the relative aversiveness of different husbandry practices.[13][14]

The aversiveness of electroejaculation, part-shearing (one eighth of the wool was removed each time) and free movement through an experimental route were compared in an aversion trail in which groups of eight rams were subjected to one of these procedures twice daily for 4 days. The relative aversiveness of the procedures was monitored by recording the time taken (transit time) to move through a route to the catching pen where the treatment took place. The transit time for free movement was significantly ($P<0.05$) lower than for part-shearing. Transit time for electroejaculation was lower than that for part-shearing and higher than for free-movement but not significantly so. These results indicate that electroejaculation is not more aversive than part-shearing and suggests that it may be less aversive (Stafford, unpublished data). A probe with a ring electrode was used in this trial and the rams were restrained in lateral recumbency. The rams did not find electroejaculation administered in this manner a rewarding procedure as the transit time increased which suggests that the procedure was aversive.

Confident, sexually active goats did not resist entering the compound where electroejaculation was carried out and showed no signs of aversion to repetitive electroejaculation when it was carried out using a probe with longitudinal electrodes and in the standing position.[4]

Changes in the plasma cortisol level of animals subjected to different handling procedures has been used as an indicator of the degree of distress being experienced by animals.[15][16] The increase in the plasma cortisol levels of rams subjected to electroejaculation was greater than that of rams restrained as for electroejaculation which was greater than that of rams from which semen was collected by AV. These results suggest that electroejaculation is a more distressing procedure than semen collection by AV.[17] The rams used in this experiment were regularly handled and used to being blood-sampled without restraint.

In another experiment there was no significant difference in the increase in plasma cortisol levels in rams subjected to shearing, electroejaculation or lateral restraint. These results suggests that the three procedures produce a similar degree of distress (Stafford, unpublished data). The rams used in this experiment were not handled regularly and may have found being restrained in lateral recumbency a more distressing procedure than the rams in the previous experiment.[17] In both experiments the plasma cortisol levels returned to normal within 90 minutes after electroejaculation.

Plasma cortisol levels rose sharply in bulls 15 minutes after electroejaculation and remained elevated for 2-4 hours.[18] The use of plasma cortisol levels as an indicator of distress caused by electroejaculation may be questioned as there is an increase in plasma cortisol levels during normal sexual activity[19] and during electroejaculation of cats under general anaesthesia.[20] However, the difference between the cortisol response to ejaculation by AV and electroejaculation indicates that electroejaculation itself may be a distressing experience.[17]

Human experience of electroejaculation

Anejaculation is an uncommon occurrence amongst human males which may result from spinal cord injury, retroperitoneal lymph node dissection, diabetes mellitus, transverse myelitis, multiple sclerosis or psychogenic disorders.[21] Electroejaculation is used to assist anejaculatory patients wishing to procreate. The majority of patients subjected to electroejaculation have spinal cord injuries and do not need analgesics or anaesthetic. Although it is standard protocol for men with normal sensation in the perirectal area to be given a general or epidural anaesthetic before electroejaculation[22] because the procedure is a painful experience.

Effects of sedation or anaesthesia

It is common practice to sedate or anaesthetise captive animals being subjected to electroejaculation[1] and it has been suggested that analgesics or sedatives[16] should be used on domestic animals subjected to electroejaculation.

Xylazine has been used to sedate bulls before electroejaculation even to a depth where they became recumbent[23] but this practice is not without some risk to the animal.

In a study to examine the effects of the sedative diazepam or the analgesic buprenorphine on rams being subjected to electroejaculation it was observed that the necessary restraint was less forceful when the rams were premedicated (Stafford, unpublished data). Interestingly, plasma cortisol levels were similar in rams subjected to electroejaculation with or without premedication. However, the effects of the premedicants used on plasma cortisol levels in sheep are unknown and they may have influenced the plasma cortisol levels per se. After sedation, rams and bulls must be kept under observation to ensure that they do not regurgitate and develop aspiration pneumonia or become bloated during recovery or transport home from the veterinary clinic.

The effects of sedation and analgesia on the efficacy of electroejaculation does not appear to be significant but further trials need to be carried out to confirm this. There is evidence that in carnivores diazepam, xylazine and acetylpromazine relax the musculature surrounding the urethra and may cause urine contamination of semen during electroejaculation.[1] Whether this is a problem in ruminants remains unknown.

The importance of electroejaculation

Electroejaculation is the only way to obtain semen from a wide range of captive species. These animals are sedated or anaesthetised before electroejaculation for safety and handling reasons. Semen collection and storage is an important tool in the breeding programmes of many endangered species.

In domesticated animals semen collection for artificial breeding reasons is usually collected from animals trained to ejaculate into an AV. However, it is often necessary to obtain semen from animals to determine their breeding soundness.[24][25] In rams semen is collected to confirm the diagnosis of *Brucella ovis*[26] or Gram-negative pleomorphic epididymitis infections.[27][28] Collection of semen for these purposes is important.

Conclusions

Semen collection is an essential veterinary diagnostic procedure. Although there are alternatives, electroejaculation is the only practical way of collecting semen from domestic ruminants not trained to use an AV.

Electroejaculation is an aversive experience but the level of aversion is probably influenced by the probe type used and the restraint involved. Even using a probe with a ring electrode recognised as causing a high level of physical reaction and lateral restraint electroejaculation was no more aversive than part-shearing.

The increase in plasma cortisol levels of rams subjected to electroejaculation and shearing would indicate that the distress caused by electroejaculation carried out using a ring electrode probe is similar to that caused by shearing. Lateral restraint is an important component of the plasma cortisol response to electroejaculation and depending on the animal's previous experience may cause a response quantitatively similar to electroejaculation.

The use of general anaesthesia is not recommended for farm ruminants under normal conditions because of the risks involved. However, sedation or analgesia reduces the degree of restraint required to carry out electroejaculation on

bulls and rams.

In general, it is preferable to use an AV for semen collection from domestic ruminants but few of the animals being investigated are trained to use them. It is an unnecessary waste of time to spend several hours or days training a ram or bull using oestrous females to ejaculate into an AV in order to collect one semen sample. The use of oestrous females to collect semen either by condom or intravaginally post-coitus raises another set of animal welfare concerns, especially where large numbers of animals are being sampled.

- It is likely that the physical reaction caused by electroejaculation can be reduced by using a probe with ventrally positioned longitudinal electrodes which reduces the stimulation of irrelevant skeletal muscles.
- Probes in which the voltage output can be controlled or which are programmed are preferable to the older models with fixed voltage output, as the voltage can be elevated to that required for ejaculation and then stabilised.
- Sedation or analgesia will reduce the degree of restraint and probably the level of distress experienced.
- Electroejaculation should remain as a veterinary procedure but practitioners should recognise the limitations of the older probes and where possible use modern probes.
- Veterinarians should avoid prolonged stimulation of animals during electroejaculation.

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