

# Electroejaculation of the Bull

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Electroejaculation is widely used to collect semen from bulls for breeding soundness examinations and for the diagnosis and treatment of penile and preputial diseases. It is also used in artificial insemination (A.I.) centers to collect semen from bulls which are unable to serve an artificial vagina because of arthritis or other physical or psychological defects. Improper usage or poor response from bulls can result in collection of poor seminal samples or failure to obtain semen, in faulty diagnosis of penile disease, or even in excessive physical trauma (1,2,6). It is important, therefore, to use the electroejaculator properly and to recognize its limitations. It is the purpose of this paper to review some of these aspects of electroejaculation.

Electrical stimulation of pelvic nerves to cause ejaculation was pioneered by Gunn in 1936 (4). A rectal probe was used as one electrode, and a needle was inserted into the loin as the electrode of opposite charge. Rams were used as experimental animals. Refinements of this procedure led to the development of bipolar electrodes imbedded in rectal probes made of materials that insulated electrodes of opposite charge. This principle is used in modern electroejaculators.

Since its introduction, electroejaculation has been attempted on most domestic animals, but has been used most successfully with bulls and rams.

Nerves associated with erection of the penis and ejaculation, the pudendal and hemorrhoidal nerves, originate in the lumbo-sacral plexus and ramify in the region of the pelvic genital organs. Stimulation of nerves in the region of the prostate results in erection; stimulation of those near ampullae and vesicular glands causes ejaculation (2). Erection is stimulated by the parasympathetic; ejaculation is stimulated by the sympathetic nervous system (7).

The location of these nerves has significance when considering the design of rectal probes and the manipulation of finger electrodes or hand

probes to produce first erection, then ejaculation (2,6). The electrodes on rectal probes should extend to within one-half inch of the posterior end of the probe and sufficiently forward from this point to insure coverage of the ampullae and vesicular glands.

When properly used to collect semen from bulls, the electroejaculator can produce consistently satisfactory results. Carroll et al. (1) reported good penile erection in 97.67%, good penile protrusion in 95.93%, and good ejaculation in 96.06% of 5,397 seminal collections from bulls. They observed that experience was necessary for maximum success; however, the amount of training required to obtain satisfactory results is not excessive. In a recent experiment at Colorado State University, failure to obtain semen occurred in only two of 100 attempts made by an inexperienced technician.

## Procedure for Electroejaculation

In general, the following procedures should be used for optimal results, although minor variations may be required for individual bulls. With machines in which the power is increased stepwise, the process should begin at the lowest power step in attempting to electroejaculate young, small bulls. The second power step may be the best beginning point with older, larger bulls. On most machines, power within a given power step is controlled by a variable stimulating knob. Manipulation of this knob should be smooth and fairly rapid. The full power available in a particular power step is not attained until after the third or fourth stimulus. Five to ten stimuli are used in each power step, and highest power steps are utilized stepwise until the bull ejaculates. Erection and protrusion of the penis should occur before ejaculation begins; if protrusion does not occur, it can usually be induced by applying cranial pressure on the sigmoid flexure after the penis has begun to erect, but application of pressure on the

sigmoid flexure before erection begins may be counter productive. The sigmoid flexure is located just caudal to the scrotum, and pressure is applied to it, if necessary, by an assistant who also tends the rectal probe to prevent its expulsion during electroejaculation. Each stimulus should be applied smoothly, held for perhaps two or three seconds, then smoothly diminished to zero. It is important to begin a new stimulus almost immediately; the period between stimuli should be a half-second or less. If longer inter-stimulus intervals are allowed, the bull may never attain an erection or may lose erection before ejaculation is complete. The procedure is similar with ejaculators with only one power step, but more stimuli are applied before reaching maximum power.

Semen should be collected when the color of the ejaculate first begins to turn cloudy, indicating delivery of the sperm-rich fraction. Delay may result in loss of considerable amounts of semen. Semen should be collected in a tube protected by a water bath at 38°C.

Occasionally a bull will not ejaculate irrespective of the use of proper techniques. This should be suspected when there are no spermatozoa in the ejaculate although the bull has a clinically normal reproductive tract, including testes of normal shape, consistency and size. A common mistake, under these conditions, is to classify the bull as unsatisfactory on the assumption that the fluid collected is representative of the bull's semen. Instead, attempts should be made to collect semen by artificial vagina, rectal massage of the ampullae and vesicular glands, or if a hand probe or finger electrodes are available, they may be tried (1,2,3). If these methods also fail and the bull fails to serve the artificial vagina, the owner should be informed that a breeding soundness evaluation cannot be made.

#### Electroejaculators and Probes

Some electroejaculators have higher peak power than others. These variations may become significant in large bulls or with the use of large probes, since more power is required under these circumstances. A machine that might be entirely adequate when used with a hand probe or finger electrodes might be deficient if used with a rectal probe. Such considerations are important in considering the purchase of an electroejaculator. Another important consideration in purchasing an ejaculator is the availability of service. The availability of good service in the practice area is an important consideration, because most electroejaculators have to be serviced occasionally.

Bipolar rectal probes are of two general types: the ring electrode and the longitudinal electrode. Dr. I. C. A. Martin has stated that more efficient ejaculation was produced using probes with longitudinal electrodes than with ring electrodes (5). Most probes made by American companies have longitudinal electrodes, though some earlier models were of the ring type.

The longitudinal-electrode probe usually has four longitudinal electrodes of alternating polarity which are spaced evenly around a cylindrical insulating body and extend most of its length. Four electrodes allow the application of current to the nerves that cause erection and ejaculation without need to orient the probe in the rectum. However, the extra electrodes lead to excessive stimulation of muscles and a more violent physical response from the bull than is observed with use of finger electrodes or a hand probe (2,6). In one experiment at Colorado State University, 22 bulls were slaughtered at the end of a ten-day period in which they were electroejaculated daily with a four-electrode probe. Obvious hemorrhage and bruising had occurred in the heavy muscles of the thigh and gluteal region of some of the smaller bulls. This damage was attributed to stimulation of the sciatic nerve, resulting in severe contractions of the muscles of the leg. This finding may also explain the stiffness observed in some bulls for a day or two following electroejaculation.

Ejaculation in the bull can usually be produced with less power and less violent physical reaction by using hand probes or finger electrodes instead of larger rectal probes (2). This is due to more specific stimulation by the use of two small electrodes which can be oriented over the specific nerves which cause erection and ejaculation. There are some significant disadvantages to the use of finger electrodes and hand probes. The operator cannot see when erection and protrusion occur and must be informed by a second, knowledgeable person, who must also examine the penis and collect the semen. Without competent help, defects of the penis can be overlooked, or the sperm-rich fraction of the ejaculate may be collected improperly. In addition, the electrodes of the hand probe or finger electrodes are too small to cover simultaneously the nerves which cause erection and those which cause ejaculation. The hand probe must first be positioned to obtain erection, then moved forward to stimulate ejaculation. Erection is sometimes lost during the ejaculation phase, and the hand probe must be repositioned to stimulate erection again and then returned to stimulate ejaculation (2). This procedure may be repeated

several times before complete ejaculation is obtained in large or difficult bulls. It is usually not so much a problem in smaller bulls.

### Experimental Probe Designs

Experiments were conducted in an attempt to develop a rectal probe which would minimize muscular contractions.\* The first experimental probe had only two electrodes which were maintained in ventral orientation by a device which cradled the tail and prevented rotation of the probe (Figure 1). The skeletal muscular responses

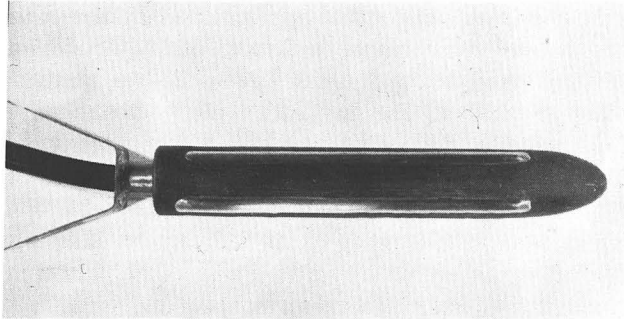


Figure 1: two-electrode probe.

of the bull were minimized with this probe, and ejaculation occurred with a low power input, but ejaculation usually occurred before erection and protrusion of the penis. Several probe types were subsequently evaluated. Unassisted protrusion preceding ejaculation was more dependably stimulated when three ventrally oriented electrodes were used (Figure 2). The length of the electrodes was a

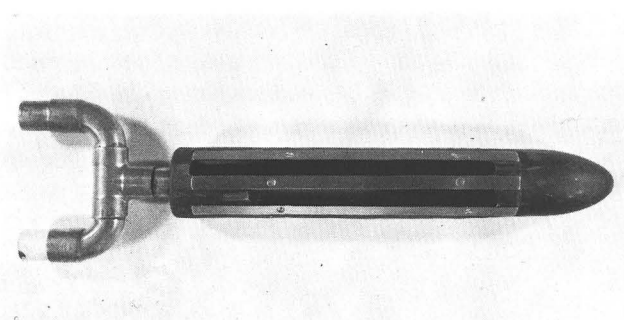


Figure 2: three-electrode probe.

constant  $23 \pm 1$  cm, but the width was varied. In some probes, the electrodes were tapered at or near midpoint so the electrodes were wider in the regions of the nerves controlling protrusion. The tapered electrodes gave no better performance than untapered, but variations in the width of the electrodes affected both protrusion of the penis and ejaculation (Table 1). Wider electrodes

stimulated earlier ejaculation, but also increased muscular contractions.

The probe selected as the one which gave optimal results had untapered electrodes 24 cm. long, one cm. wide, and one cm. between electrodes. The probe was a plastic cylinder 33 cm. long, 15½ cm. in circumference, tapered at the cranial end. The electrodes extended from 1½ cm. anterior to the posterior end to seven cm. posterior to the cranial end of the probe (Figure 2).

Table 1  
Effect of Design of Rectal Probe on Electroejaculation in the Bull

Type	Electrode		Stimuli required for protrusion	Stimuli required to begin ejaculation	Stimuli required to end of ejaculation	Number of ejaculates
	Number	Width (mm)				
Untapered	2	13	21.0	15.8	31.8	4
	3	10	10.9	16.5	29.1	8
	3	7	18.0	31.0	47.5	4
	3	5	20.8	28.2	42.0	4
Tapered	3	13-5	18.7	16.2	25.8	4
	3	10-7	13.8	18.8	30.1	8
	3	8-7	9.2	13.5	26.2	4

\*Seven stimuli were given in each successive power step until ejaculation began.

### Summary

The art of electroejaculation can be mastered with practice; however, the evaluation of semen collected by electroejaculation can be misleading if the physical condition of the bull is not considered. The greatest danger lies in classifying a bull as a questionable or unsatisfactory breeding prospect when he actually failed to ejaculate.

There are many factors associated with effective electroejaculation of the bull, including the type of rectal probe, power output of the electroejaculator, and the skill of the operator.

The design of the probe has an important bearing on the power required for electroejaculation and the associated skeletal muscular response of the bull. A rectal probe was designed to increase the efficiency of electroejaculation and to decrease the muscular contractions associated with it.

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