THE CLINICAL USE OF AN ELECTROEJACULATOR IN FERTILITY EXAMINATIONS OF THE MALE BOVINE

by

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B. S., D. V. M., Kansas State College of Agriculture and Applied Science, 1952

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Surgery and Medicine

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1955

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INTRODUCTION

The purpose of this work was primarily to establish a workable method of collecting semen from bovine males with a history of infertility which were presented to the Department of Surgery and Medicine, Kansas State College.

There are established methods that have been used and are now being used which are not entirely satisfactory. The artificial vagina method and the method of manual palpation of the ampullae of the ductus deferens and the seminal vesicles are methods that have been used in the past.

An attempt will be made to show that in practical application of clinical work, this electroejaculation method is superior to the other two.

REVIEW OF LITERATURE

Massage Method of Collection

Semen may be collected from the bull by massage of the ampullae of the vasa deferentia. Miller and Evans (22) suggested the following technique: The bull is tied in such a manner that he cannot move from side to side. The sheath must be carefully washed with a soft brush and warm water. This usually stimulates urination and helps to prevent contamination of semen by the urine. A well lubricated rubber gloved hand is placed into the bull's rectum. The seminal vesicles are stroked first and seminal fluid with few spermatozoa is expelled. The ampullae of the vasa deferentia are massaged in a similar manner. The fluid from

the latter ducts are very rich in spermatozoa. Volumes received from 81 collections from 100 massages of 15 bulls ranged from 0.5 to 23 cc. The semen may be collected from the penis or the sheath by funnel and test tube held by the assistant.

The ejaculate may sometimes be retained in the sigmoid flexure of the penis (Frank, 13). To avoid this the operator should straighten this flexure with his hand after massaging the ampullae. Anderson (1) stated that this method should be used only when a specimen cannot be obtained with an artificial vagina. It is useful with valuable breeding bulls which are unable to serve cows in a normal manner because of injury. Kingman (18) stated that with collection of semen by massage, contamination of the specimen cannot be avoided. Clapp (7) stated that the skill of the operator is a main factor in this method. It takes less time ordinarily than to take a cow to a bull on another farm, or to breed the cow to a slow-serving bull.

Anderson (1) reported that the advantages of the massage method are that semen is gained quickly and easily after the operator has gained experience and the bull has been trained, that no special equipment is necessary, and that proved bulls which for some reason are unable to mount a cow may be kept for service.

Davis, et al. (9) found the conception rate of semen collected by massage to be only slightly less than the conception rate of semen collected with the artificial vagina.

Artificial Vagina Method of Collection

Perry et al. (24) suggested the artificial vagina should consist of a rubber cylinder 16.5 inches long, and 2.75 inches in diameter, fitted with an inner tube, the ends of which are turned back over the ends of the cylinder and held in position by heavy rubber bands or string. Near one end of the cylinder is a hole to admit water. This hole may be covered with a screw cap or one end of the rubber tubing. The large end of a funnel-shaped piece of rubber tube is slipped over one end of the rubber cylinder and a test tube is fitted to the other end. Other artificial vaginas of various sizes and materials are designed, but the essentials are the same.

The temperature of the artificial vagina should be adjusted by warm water and should never be over 115°- 120° F. at the time of collection as higher temperatures are harmful to spermatozoa. It may be as low as 97° F. provided this does not prevent ejaculation. (Perry et al., 24). A non-spermicidal lubricant should be used at the end of the artificial vagina (Frank, 13).

For collection of semen on farms a cow in heat is usually available, preferably an older cow which has been handled a lot and stands quietly. The cow was tied to a post with a halter. The ground should be level and not slippery. A cow not in heat can be trained or placed in a service crate so that she must stand and be used very satisfactorily. (Anderson, 1).

The bull should be permitted to mount the cow. The artificial vagina is raised close to the flank of the cow behind the

bull's foreleg with the opening directed towards the penis, i. e., at about 45°. The penis is directed into the artificial vagina with the left hand which grasps the sheath. The penis should not be touched with the hand as this may cause retraction. When the penis enters the artificial vagina, the bull thrusts vigorously forward and upward and ejaculates. (Anderson, 1).

Examination of Semen

The ejaculate of a normal bull of good fertility is an opaque, whitish or whitish-yellow fluid.

The average volume of bull semen is about 4 ml. It may vary from 0.5 ml. to 12.0 ml. The amount varies considerably with the same bull from time to time, and with different bulls.

Herman and Madden (17) noted that the initial motility varied less than any other characteristic of semen. There was a striking difference in motility between good and poor bulls, but this was not 100 per cent true.

According to Lagerlof (19) motility tends to be poorer when other semen characteristics depart from normal. It is seriously affected by abnormal conditions of the genital organs. In epididymitis it is either poor or absent. In atrophy or hypoplasia of the testes it is reduced. He further reports that the number of abnormal spermatozoa in fertile bulls does not usually exceed 17 to 18 per cent.

The estimate of motility although of great practical value is largely subjective. A method of evaluating semen motility has been worked out by Herman and Madden (17).

The average number of spermatozoa per mm^3 is about 600,000 to 1,000,000, but a wide range of variation occurs even in fertile bulls (Anderson, 1). Lagerlof (19) found that the number varied from 300,000 to nearly 2,000,000 per mm^3. He also noted the effect of disease on concentration of spermatozoa. With slight degenerative changes in the testes the number was almost normal; when the changes were marked, the number of spermatozoa was greatly reduced or absent. With infectious changes or fibrosis of the testes, spermatozoa are few or absent. These changes were true when the damage of the epididymus and testes were palpable and, also, when no detectable abnormalities were present.

Swanson and Herman (27) used the following classification: 1. Tailless; 2. Coiled tails; 3. Pyriform heads; 4. Other head abnormalities; and 5. Body abnormalities. The most common form found was coiled tails. The next most common was tailless, closely followed by pyriform heads. Other head abnormalities were damaged heads, tapering or pointed heads, small and large heads, phantom heads, and undeveloped spermatozoa; these were quite rare.

Lagerlof (19) has shown that the number of abnormal spermatozoa increased in cases of testicular hypoplasia (average 42 per cent), and in degenerative testicular atrophy (average 36 per cent).

Anderson (1) observed the relationship of p^H and fertility of semen. He suggested that the probable fertile range is from 6.0 to 7.5 with samples from 7.0 to 7.5 of doubtful fertility. He also

stated that an alkaline reaction was characteristic of a typical case of epididymitis or testicular hypoplasia. The alkalinity of semen is associated with a decrease of motility. Swanson and Herman (26) found that conception rate was not significantly correlated with p^H, abnormal spermatozoa, or concentration of spermatozoa, but was highly correlated with duration of motility and initial motility.

Terrill (29) indicated favorable results in measurement of high fertility in examining the semen of rams.

Electroejaculation Method of Collection

An electrical apparatus was used by Gunn (15) as early as 1936 for the collection of semen from sheep. It was of six volts with a transformer to raise it to 50 volts and about two amperes current. A small interrupter and reverser was used to produce the alternating current. A sliding resistance was used to control milliamperage. The electrode was of thick copper wire, insulated except at the free end by waterproof tape. The other electrode was introduced into the longissimus dorsi muscle. The ram was strapped to a table and the collection was made by this machine.

Batelli (2) was apparently the first to use electrical stimulation. He used it to collect the semen of guinea pigs in 1922.

Benham and Enders (3) used an electrical stimulator of the two electrode type on foxes, one in the rectum and one in the muscles near the third lumbar vertebra. They tried stimulations

from 115 volts at 60 cycles per second with 35 milliamperes for seven seconds, to 40 volts at 25 cycles per second with 30 milliamperes for only two seconds. They found that the latter was adequate in most cases and that there were no death losses at this level.

Biocca and Cerquiglini (4) reported on an electrical apparatus to collect semen from a South American fur-bearing rodent, the nutria.

Brady and Gildow (5) and Terrill (28) used a two electrode electrical apparatus on sheep to compare it to the artificial vagina method and the method of collecting from the vagina of a ewe after being bred. Terrill (28) reported that electrical stimulation produced thinner semen, poorer motility, and the number of spermatozoa per collection was more variable than semen collected by an artificial vagina. He also stated that collection by electrical stimulation was the quickest method. Brady and Gildow (5) further stated that one indication for electrical stimulation is for collection of semen from rams that will not or cannot serve a real or dummy ewe.

Dalziel and Phillips (8) reported on optimum electric shock to produce ejaculation in chinchillas and guinea pigs. They determined this by use of a machine of the two electrode type, using eight to 16 milliamperes with an "on period" of about three seconds and an "off period" between shocks of about 12 seconds. Frequencies of 500 - 1500 cycles per second were considered best, and four or five shocks were required to produce an ejaculation in about 83 per cent of the animals.

A report by Durfee, et al. (10) of electrical stimulation of rats and rabbits suggested that the optimum stimulation is 13 volts, 15 milliamperes, with a time of two to four seconds. Their electrical contacts were the rectum and third sacral vertebra area. There is danger of electrocuting rats if over 24 volts are used.

According to Perry and others (24) the electrical method was tried on poultry in 1934 by Serebrovsky and Sokolovsky, but the yield was not good, and there was danger of burning the bird. The manual massage method is used in poultry and has been quite satisfactory, but practice on the part of the bird as well as the operator is necessary for the best results.

Moore and Gallagher (23) reported the use of 33 volts to produce ejaculation in a guinea pig. The pig was anesthetized and placed ventral side up. One electrode was applied to the base of the skull and one in the mouth. Three ten-second stimulations with one-minute intervals were employed. Vigorous body contractions and ejaculation were observed. There was no urination or defecation. The animals made a normal recovery within one hour.

Others have worked this technique into a bi-polar technique on rams. Thibault, et al. (30)adapted this technique to the stimulation of bulls. He used 60 cycle alternating current which varied from zero to 50 volts. Mascarenhas and Gomes (20) used a multi-ring probe with 15 volts current, but later dropped to five to ten volts.

Dzuik, et al. (11) used the multi-ring, bi-polar probe and a 30 volt 60 cycle alternating current impulse. The impulse was

varied by a variable transformer. The technique was to give an enema of two quarts of five per cent sodium chloride after which the prepuce was clipped and brushed. The probe was lightly lubricated and placed into the rectum at various distances, depending upon the size of the bull. Best results were obtained when the probe was held on the ventral side of the rectum. Stimulations were increased progressively. Erection and muscular reaction usually started at the five-volt level, but ejaculation usually occurred at the 10 - 15 volt level. At the time of stimulation many motor nerves are stimulated, and general tetany of the hind legs results. They found that a good stanchion and sound footing were all the restraint necessary for collection.

Dzuik, et al. (11) also reported that conception rates of semen collected by electroejaculation were quite comparable to that collected from the same bulls by the artificial vagina the previous year.

Fulton (14) stated that the impulses which elicit ejaculation are parasympathetic and travel over the pudendal nerve. It is also generally considered that an ejaculator center in the lumbo-sacral spinal cord integrates the afferent and efferent impulses which cause the emission of semen.

Marden (21), after trying many types, designed his probe to be a 13-inch cylindrical lucite electrode 1 7/8 inches in diameter, inlaid with four brass electrodes 11 inches long and 5/16 inches wide. They were connected in pairs 180 degrees apart. The entire electrode was placed inside the anal sphincter to reduce the discomfort. He further found that the optimum frequency

cycle was between 20 and 30 cycles. The maximum voltage used was 5.5 volts and a maximum current of 900 milliamperes.

The technique (Marden, 21) was to place the lucite electrode into a bucket of warm water before placing it into the rectum of the bull. Stimulations were made by gradually increasing the current into the electrode over a period of three to eight seconds and then returning it to zero. Resting periods of five to 15 seconds were allowed between stimulations. Each successive stimulus became higher until erection and ejaculation were obtained.

Marden (21) suggested that electroejaculation offers a method for fractionation of the ejaculate. The true sperm-containing portion may then be obtained in a concentrated form. He further suggested that the instrument should enhance the use of heavy bulls or bulls unwilling or unable to mount, save time in the use of slow bulls, and be helpful to veterinarians during sterility examinations.

Rowson and Murdoch (25) suggested that the use of two copper rings worn on the fingers of a rubber gloved hand and held on either side of the ampullae produced good semen with less muscular reaction.

Hale, et al. (16) ran exhaustion studies on bulls, and Marden (21) reports having produced an erection and an ejaculate from one of the bulls that was classified by them as being generally inhibited.

Dzuik and others (12) have successfully used their machine with modifications of electrode on rams, boars, and a goat.

MATERIALS AND METHODS

The apparatus used was made by the Electrical Engineering Department of Kansas State College. The apparatus was made to produce an output from zero to 18 volts and a current from zero to one amperes with an alternating sine wave current of 30 cycles per second.

To accomplish this purpose an 1800 R.P.M. motor was connected directly into the 110 volt line. A fuse of 1 1/2 amperage capacity was placed in the line to protect the apparatus. It should be observed that by running the generator at one-half of its rated speed, it also reduced the cycles by one-half. A 3600 R.P.M. 60-cycle generator was powered by the aforementioned motor. The field for this generator was supplied by three six-volt lantern type batteries in a series connection. Variation in field current was produced by adjusting the output of a potential divider.

A probe was made of bakelite with wooden end plugs. There were four copper electrode strips placed longitudinally each 90° around the probe. These were wired so that each electrode was of opposite polarity from the adjacent electrode. The electrodes were partially imbedded so as to make a smooth surface over the entire probe, and it was then sealed so as to be as nearly watertight as possible. The over-all length of the probe was 14 1/2 inches with a diameter of two inches, and the length of the electrodes was 12 1/4 inches. The probe was designed so that it might be placed completely inside the anal sphincter as this is

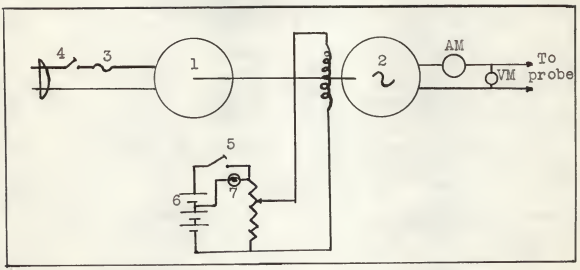


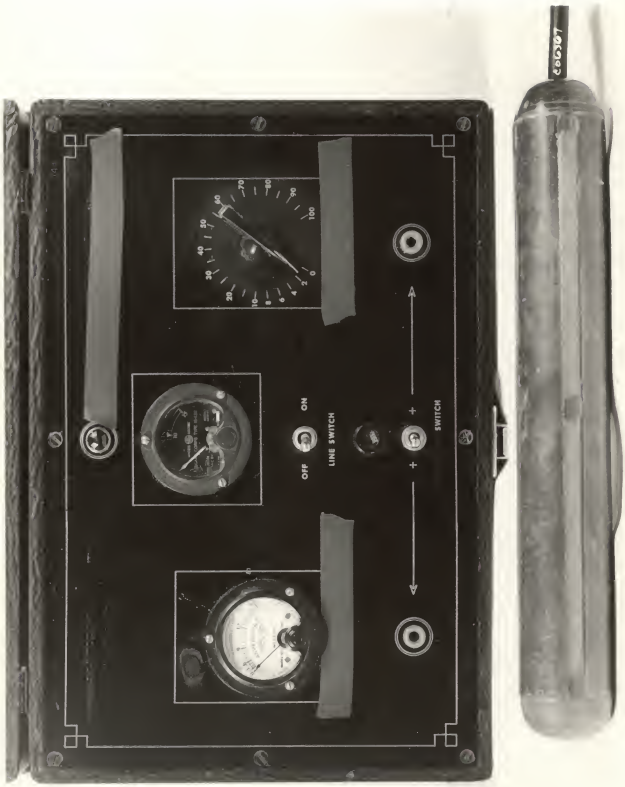
Fig. 1. Schematic circuit diagram of the electro-ejaculator.

1. 115 volt, 1800 R.P.M., 1/100 hp AC motor.
2. 30 volt, 3600 R.P.M., 1 ampere, 60 cycle, AC
3. 1 1/2 ampere fuse
4. Motor on-off switch
5. Alternator field on-off switch
6. Lantern batteries
7. 6 volt indicator lamp

EXPLANATION OF PLATE I

Photograph of the Electroejaculator

PLATE I



thought to be more comfortable for the patient. (Marden, 21).

A glass funnel and a 10 ml. graduated tube were used to collect the semen ejaculated.

The apparatus used to restrain the animals was variable. Stanchions with concrete floors, stanchion chutes with rough steel floors, stanchions with rubber mats on floors, and standard chutes of several makes and descriptions were used.

Both beef and dairy type animals were used in this experiment.

Observations were made for erection, muscular reaction, semen volume, semen motility, semen concentration, and abnormalities of the genital tract or other parts of the anatomy.

RESULTS

The equipment has previously been cited. The most advantageous technique used was as follows: The bull was restrained preferably to a chute with stanchion head piece, solid non-slip flooring, and with the sides spread at the base for maximum footing. This gave the bull a maximum of freedom to retain his footing, and still afforded the collector a maximum of protection. The bull also had something to press forward against which seemed to enhance the ejaculation process. It was then necessary to remove as much of the feces from the rectum as possible. This process was better accomplished without the aid of soap or any insulating lubricant. The electrode was thoroughly wet with approximately five per cent sodium chloride solution. Also, it has been helpful to give an enema of at least one quart

of the five per cent saline solution as suggested by Dzuik, et al. (11). The electrode was placed into the rectum so that the external portion was just inside the sphincter ani muscle, allowing it to close upon the electric cord as suggested by Marden (21).

The collecting apparatus used in this experiment was of the funnel and test-tube variety. Care should be taken to hold the test tube firmly in the hand for a short time to bring the temperature near that of body temperature and thus partially eliminating the possibility of cold shock to the spermatozoa. The collecting apparatus suggested by Dzuik, et al. (11) would likely be necessary if the semen were to be used for insemination.

The actual stimulation varied tremendously with the individual bull. It was found that the bulls also responded differently from one time to the next. An attempt was made to simulate the act of masturbation in bulls. The early stimulating at low levels and allowing the bull to drip the pre-sperm fraction seemed to produce a more concentrated ejaculate than by rushing them into a quick ejaculate. The prolonged use of this procedure seemed to cause difficulty obtaining an erection and sometimes in getting a good ejaculate.

The procedure for stimulating bulls was to turn up the current until reaction was observed, then return to zero. A pause was made of about one second. The first procedure was repeated, but the reaction or current was slightly increased and held slightly longer, then again returned to zero. It was necessary to repeat this procedure again and again each time increasing the time and the current. The first observations made were

usually elimination of the pre-sperm clear fraction, and the sliding of the penis within the sheath. As the stimulation progressed, an erection was observed in most cases. The ejaculate usually followed quite readily and the assistant had to be alert or he would miss much of the ejaculate. Collection should be made when possible from the right side of the animal, because it enables the right-handed assistant to grasp the sheath with the left hand and thus direct the penis. The reaction is usually greater on the right side and in most instances the bulls directed their thrust toward the right side of the chute or stanchion.

Violent muscular reaction, an undesirable effect, accompanied the electrical stimulation. This reaction was most pronounced in thin, dairy-type bulls. As the stimulus was increased, these bulls would extend one or both hind limbs. Perhaps the reason for this was that the rumen tends to hold the probe over against the right side of the pelvis, letting it come in closer contact to the nerves on the right side. Some bulls raised their hind quarters off the platform and did a lot of bellowing. Reference is made to the article by Rowson and Murdoch (25) in which they suggested that the placing of two copper rings upon the seminal vesicles and ampullae helped to eliminate some of this reaction. This was attempted on a limited number of bulls to find that it made very little difference in the muscular reaction, but ejaculation results seemed less consistent. The use of a saline enema with the original electrode, however, did cut down this reaction to a great extent.

Of the bulls examined to date, there were only two young

dairy bulls from which there were no spermatozoa collected. These were restrained in a stanchion on a concrete floor, and there was considerable slipping. They did not receive the full current of the machine, and, incidentally, they were the first bulls that this machine was used on. An unsuccessful attempt was made to collect semen from these bulls by the manual palpation method.

Semen from two Holstein bulls was collected approximately twice each week for a period of four weeks. Tables 1 and 2 illustrate that the semen collected from these dairy bulls was quite variable within the individual from time to time. The semen collections were made while the bulls were standing on concrete floors which made their footing insecure. The bull would fall frequently when approaching ejaculation levels, making it necessary to begin again. Readings of concentration were taken by the use of a calibrated colorimeter.

Table 1 indicated the results of electroejaculation of a bull which normally produced with the artificial vagina 50 - 60 per cent motility, and concentration ranging from 1,000,000 to 1,200,000 cells per cubic millimeter. This bull had very bad hind limbs and feet making it difficult for him to mount a cow. He showed no actual fear of the machine, but would at times drip seminal fluid when the motor was running even before he was cleaned rectally, or before he was stimulated in any way.

Table 2 indicated the results of electroejaculation of a bull which had not been collected for four or five months. He had previously worked well on a cow in heat, but was somewhat exciteable and dangerous otherwise. This bull manifested the most

Table 1. Results of semen collections from Holstein No. 1 by the electroejaculation method.

Collection Number	Volume cc	Motility per cent	Concentration per mm^3	Erection	Muscular Reaction	
1	low*	40	low*	no	mild	
2	low*	40	low*	yes	mild	
3	3.5	50	500,000	no	mild	
4	4.5	50	low*	no	mild	
5	2.5	50	820,000	no	mild	same day
6	3.0	30	1,100,000	no	mild	same day
7	5.0	60	800,000	yes	mild	
8	2.5	30	low*	yes	mild	

Table 2. Results of semen collections from Holstein No. 2 by the electroejaculation method.

Collection Number	Volume cc	Motility per cent	Concentration per mm^3	Erection	Muscular Reaction
1	1.0	30	775,000	yes	medium
2	low*	0	low*	yes	medium
3	low*	10	500,000	no	violent
4	7.5	40	26,000	yes	violent
5	1.8	60	2,003,000	yes	violent
6	3.5	20	low*	no	violent
7	2.0	50	300,000	yes	violent
8	1.75	40	low*	no	violent

* Too low for accurate measurement.

violent muscular reactions.

Cases examined were similar to the case examples cited on the following pages. Sixty separate collections from 44 bulls were made including the two from which semen was not obtained. The case examples show that semen variability was not so great in beef type bulls. The muscular activity has been much less pronounced in fat bulls.

Case Example No. 1

This Hereford bull had settled few cows. The cows he had been observed to breed had settled. He would follow the cow, but fail to mount.

Electroejaculation with saline enema produced 2.5 cc. of 50 per cent motile semen and a concentration of approximately one million spermatozoa per mm^3. The left stifle joint appeared somewhat enlarged. The penis appeared to be normal, and erection was pronounced. A diagnosis was made of gonitis.

Case Example No. 2

This Angus bull was returned to the original owner with a history of infertility.

Electroejaculation produced one cc of 10 per cent motile semen with an extremely low concentration. Repeated attempts did not improve on this sample. There were found approximately 50 per cent abnormal spermatozoa with cytoplasmic droplets of the body and tail most common. One motile split-tailed spermatozoon was observed. This bull was assumed to be of very low fertility.

Case Example No. 3

The owner reported trouble with previous bulls. The cows did not settle, or the calf crop was scattered from January to May.

The electroejaculator was used to collect semen from 25 Angus bulls from three to five years of age. The time consumed in this operation was four and one-half hours. The electrode and the funnels were washed in a sterilizing solution, then thoroughly rinsed in water and dipped into a saline solution before using them on the next bull. A clean collection tube was used for each collection. When a sample was not considered good, an attempt was made to collect another sample. No bull was condemned on one sample alone.

Two bulls were found to be of questionable fertility because of low concentration and motility, and one bull with a preputial laceration that inhibited the extension of the penis was eliminated. Semen samples from all other bulls were of good quality. Erection was observed in 21 of the 25 bulls.

Case Example No. 4

This Angus bull was presented to the hospital with a history of infertility. The ampullae were manually massaged for approximately one hour with no results.

The following day electro-stimulation produced an ejaculate of 3 cc of 30 per cent motile spermatozoa. The concentration was very low. An erection of the penis was present at the time of

ejaculation. The time consumed for the actual stimulation was approximately five minutes.

Case Example No. 5

A Hereford bull was presented to the hospital with a history of sterility. This bull previously had Corynebacterium renale isolated from his semen for which he had received treatment.

Electroejaculation with erection made it possible to collect a sterile semen sample from which Corynebacterium was again isolated. The semen on several ejaculates was of 60 to 80 per cent motility with a concentration of approximately one million spermatozoa per mm^3. This was suggestive that the organism was being harbored in the kidneys, bladder, or ureters, or perhaps in the accessory reproductive glands rather than in the testes.

DISCUSSION

The electroejaculator has the following advantages for clinical application: It is safe from the electrical standpoint if properly constructed. It enables one to collect semen from bulls which are not trained to hand-breeding or to the artificial vagina without endangering himself. It affords the examiner the possibility of examining the penis, prepuce, and other genitals with much less danger. It has a control over the hind limbs of the animal so that examination may be done with a reasonable amount of safety. Time is an important factor. Case example 4 illustrates that time may be saved over the palpation of the ampullae and seminal vesicles. A minimum of time is spent in

preparing and cleaning equipment. It eliminates time in teasing and waiting for slow bulls to work as shown by case example 1. Time is saved when it becomes necessary to collect semen from a number of bulls at one time in that they may be run into a chute one after another and be ready by the time the semen of the last bull has been examined. As shown in case example 3, the author had occasion to collect and examine the semen from 25 bulls in one afternoon.

Time and money should be saved by the livestock man who takes advantage of this service. It should enable him to eliminate bulls of low fertility and, consequently, produce a larger and more uniform calf crop. Along with the elimination of bulls that are not doing their share, it should prevent other bulls from becoming infertile from over-use. It should be advantageous for breeders of registered bulls to be able to sell bulls with known high-quality semen.

The advantage of disease control is great. There is no need for association with other animals, and there is less equipment to keep sterilized.

It is not the purpose of this paper to suggest that one type of electroejaculation is better than another, but rather to point out that the one used in this experiment is satisfactory for clinical use. It is felt that there is room for improvement, and that there will be improvement in the machines available. There should be work done to eliminate more of the muscular side-reactions which are not necessary for the ejaculation, as well as to increase the reliability of collecting high-quality semen at each

attempt. The machine itself could use greater amount of power available as it has been difficult at times to produce an ejaculate. Removal of the electrode and an additional saline enema has been necessary on several occasions in order to produce an ejaculation from very fat bulls.

There has been no claim that semen collected by this method is better than that collected by the artificial vagina method. This has not been found to be true. However, it is much easier and much safer to collect semen from bulls that have had no training to the artificial vagina or bulls that for some reason are slow or unable to mount the real or dummy cow. Examples of this are bulls with gonitis, spondylitis, and bad feet and legs from other diseases or conditions.

SUMMARY AND CONCLUSIONS

The data presented previously has shown that an electroejaculator can be adapted to clinical use. It should be remembered that it is a method of collection only and that the evaluation of semen is quite important. This method has the advantage of speed over the artificial vagina method used on untrained bulls, and the advantages of speed and quality of semen over the rectal palpation method of collecting semen. The electroejaculator provides greater safety to the operator when collecting semen from bulls which are not accustomed to the artificial vagina or handlers. It also affords a method in which a more complete examination of the penis, prepuce and other genitals may be performed, as well as a method of control over the hind limbs of the

bull, thus eliminating much of the danger of being kicked.

Electroejaculation saves the examiner time and handling of equipment over the artificial vagina method, thereby making these examinations less expensive to the owner.

This method enhances the checking of bulls' semen which insures larger and more uniform calf crops through the use of bulls of known high fertility.

ACKNOWLEDGMENT

The writer wishes to express his sincere appreciation to Leo Wirtz for his material assistance in the electrical portion of this thesis, to Earl L. Farmer of the Kansas Artificial Breeding Service Unit for his enthusiasm as well as for the use of the two Holstein bulls, and to the faculty of the Department of Surgery and Medicine for their interest and cooperation with the various cases involved in this thesis.

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THE CLINICAL USE OF AN ELECTROEJACULATOR IN FERTILITY EXAMINATIONS OF THE MALE BOVINE

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AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Surgery and Medicine

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1955

The object of this work was to perfect a more rapid and workable method of collecting semen from bulls for clinical tests.

Rectal massage, artificial vagina, and electric stimulation are methods of collecting semen from animals for testing purposes and artificial insemination that were developed during the twentieth century.

Massaging of the ampullae of the vasa deferentia has the advantage of less equipment, but produces poorer quality semen. It takes a maximum of time and requires more training for the bull and the operator.

The artificial vagina collection method consistently produces the best quality of semen. This method requires more sterilized equipment and there is some training necessary for both the bull and the operator. A cow in heat is necessary for collecting semen from untrained bulls.

The electroejaculation method has been used on many species of animals. Two electrodes have been used attached either to the mouth and base of the skull or the rectum and the region of the lumbar vertebrae. The bi-polar electrode method applied in the rectum is the one that is at present most popular.

The electrical apparatus used in this problem produced an output of from zero to 18 volts and from zero to one ampere of a 30 cycle alternating sine wave current. The rectal probe consisted of four longitudinal copper electrodes placed at 90° intervals around a sealed bakelite tube. Adjacent electrodes were of opposite polarity.

The main emphasis on semen quality was placed on semen volume, motility, concentration, and morphology. In this study considerable attention was directed toward genital and other anatomical abnormalities.

The animals were restrained in chutes and stanchions. The technique which proved most successful entailed the removal of the feces, an enema of five per cent sodium chloride solution, and the placing of the probe into the bull's rectum so that the sphincter ani muscle could close on the electric cord. Ejaculation was accomplished by repeated stimulations at one second intervals. The electrical current was progressively increased with each stimulation.

The pre-sperm fraction of the semen was usually followed by an erection and a rapid ejaculation. The semen was collected in a funnel and calibrated test tube.

Excessive muscular reaction, an undesirable condition that is unnecessary for ejaculation, was observed especially in thinner dairy-type bulls. The use of the saline enema reduces this to a great extent, but work should be done to eliminate this undesirable effect.

Sixty separate collection trials were made on 44 different bulls. Two bulls failed to respond to the electroejaculation or the palpation methods. Series tests were made on two Holstein bulls which showed that individual semen quality varied periodically. The quality was usually inferior to that collected by the artificial vagina method. The electroejaculator proved to be the superior method of collecting semen for diagnosing cases of

infertility with abnormal spermatozoa, low motility, and bacterial infections; also in cases of posthitis, balanitis, and gonitis; and in prophylactic testing of range bulls.

The electroejaculator used in this problem offers the following advantages over the other two methods: The chance for injury to the operator is decreased. It takes from three to ten minutes to collect semen from a bull. There is less equipment to clean than with the artificial vagina method, and it is much more reliable than the palpation method. The chance for the spreading of infection is reduced and it serves as a method of collecting semen from bulls that for some reason are slow or are unable to mount a real or dummy cow.

This method enhances the checking of bulls' semen which insures larger and more uniform calf crops through the use of bulls of known high fertility.