

Sterility In The Bull

Condition of sire important in herd fertility

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STERILITY is a pathological condition which has been more concisely termed the reduction or absence of fertility. Previously considered by members of the veterinary profession as being a rare occurrence, the problem is now receiving its due share of emphasis as a frequent affection of United States cattle herd sires. The development of artificial insemination with a more intensified form of cattle production in the last decade has brought this condition to the attention of the veterinarian. Formerly, it has been the policy of the farmer to simply discard, or sacrifice for meat, any bull which did not seem to be getting a proper conception rate. Rarely did the owner keep any breeding records to serve as an aid to the practitioner in the diagnosis and treatment of sterility.

Economic Importance

The economic importance of breeding ability of the herd bull could be determined in money value only with great difficulty. The loss derived from sterility in one bull used in an artificial insemination ring today could be very high since so many cows can be bred to a single sire. The records of an association are usually quite complete and the condition can be noticed very quickly by a systematic and complete examination of these available data.

The loss derived from the sire of a single beef or dairy herd may be sufficient to force an owner out of business. The loss in terms of prolonged dry periods of the cows, erratic periodicity of the calving of a number of cows and potential value of the offspring is of most importance to the dairyman and the purebred cattle breeder, where the cows must calve at a specific

time or at regular intervals to insure maximum production by the herd. The loss in terms of meat and dairy products is of greatest importance during the present emergency since any decrease in production of these items means that either our own servicemen, our allies or our war workers at home will go in want of these foods.

The loss in terms of potential offspring is of most importance to the future of a breed. To what extent this condition has served as a detriment to the advancement of our breeds of cattle would be difficult to estimate. The prolonged dry periods in the cows make them unprofitable to keep in the herd and may consequently be discarded because of a condition in the bull. The erratic periodicity in the calving is of importance to both the dairyman and the rancher. The dairyman attempts to have his cows calve at regular intervals to insure a certain level of milk production throughout the year. The ranchman attempts to have the range cows calve at as near the same time as possible each spring to have a uniform calf crop for the fall feeder market.

Main Forms

Lagerlof¹ has distinguished 3 main forms of sterility in bulls. They are (1) a type in which sexual desire is non-existent, (2) incapacity to copulate or impotencia coeundi and (3) incapacity to fertilize or impotencia generandi.

The first form may be observed in older bulls which have become accustomed to a certain habit and any disturbance in the routine may be met by indifference on the part of the bull. This form is probably noticed more frequently where an artificial

cow is used in the collection of semen to be used in artificial insemination. Sexual desire may be non-existent in young bulls when they are first placed in service since they are apparently quite ignorant of their role in life. Suitable stimulation in the form of an older bull as competition may be the deciding factor in arousing sexual desire in these cases. This type of sterility is also noticed in cases where the bull has overexerted himself in the preparation for coitus and pain is evidenced at each attempt to mount the cow. This type may also be manifested as a diminished sexual desire in other forms of sterility.

Incapacity to Copulate

The second form, or incapacity to copulate, may be due to many causes. Inflammatory changes in the penis and prepuce may cause such great pain to the bull on erection of the penis as to prevent copulation. This is sometimes observed in Angus bulls on the range where the rough vegetation traumatizes the partially protruding penis of the bull. Obesity may be a factor in this type of sterility in which the bull becomes very fat and "pot-bellied" due to overfeeding of rich or bulky feed and lack of exercise. The markedly pendant abdomen serves as a barrier to coitus. Any injury to the back, hips or hind legs of the bull may result in inability to mount the cow for coitus. Arthritis of the joints of the posterior region will result in the same condition. Rickets of the young bull may lead to distortion of the bones and joints of the hindlegs.

Inability to Fertilize

In the third form, or inability to fertilize, coitus occurs in a normal manner but pregnancy does not develop due to some pathological factor in the semen of the bull. This type is not noticed by the owner until a great many cows have not conceived and are returned for service several times. The causes of this form are quite variable. It may be evidenced as a testicular hypoplasia in which the spermatogenic cells of the testicle have not de-

veloped normally. This leads to decreased production or an absence of sperm, the degree of sterility depending on the numbers and viability of the sperm present. Heredity has been noted as a factor in some of the cases of testicular hypoplasia, especially in inbred lines. Degenerative changes of the epithelium of the seminiferous tubules are the most common disturbance of spermatogenesis. These may be due to several factors, among which are hormonal unbalance and the high fevers of generalized diseases. The epithelium of the seminiferous tubules seems very susceptible to degeneration from fever and heat, as is shown artificially by covering the scrotum with an insulating material. The normal heat regulating function of the scrotum is thus interfered with and dysfunction of the spermatogenic cells comparable to that of a cryptorchid testicle results.

Orchitis

Orchitis may be a cause of the sterility in the bull. Inflammation of the testicles causes a pressure necrosis of the spermatogenic cells for the heavy tunic around the testicles will not expand on internal pressure. Pressure atrophy of the spermatogenic cells and fibrosis of the entire testicle follows. Orchitis in the bull commonly is due to some infective agent, usually *Brucella abortus*, *Mycobacterium tuberculosis*, streptococci and other pyogenic bacteria. Trichomoniasis is thought to produce a balanitis and not a true sterility in the bull. It should be remembered, however, that the bull may transmit the trichomonad to a susceptible cow during the act of coitus and cause failure of conception or abortion early in pregnancy.

The exact role of hormone disturbances in sterility of the bull is not definitely known. It is possible that an unbalance of the endocrine system could result in lowered fertility due to its complex interrelation with genital function.

Nutrition is an important consideration in the fertility of the bull. The relationship of calcium, phosphorus and Vitamin D to rickets may be a factor in sterility since arthritis and distorted, swollen hind

limbs in the young bull may prevent coitus. The overfed animal may become lazy and fat and be a non-breeder. Debilitated and emaciated animals could not be expected to be sexually sound since the testicles are easily affected by extrinsic factors. Hence, an unbalanced diet need not be the cause of a case of sterility but could easily be associated with the condition. The role of Vitamin C in lowered fertility of the bull has often been discussed. Ruminants are able to synthesize this vitamin in the rumen but cases of lowered blood levels of ascorbic acid occur in conjunction with lowered fertility which improves on Vitamin C therapy. Vitamin E has been blamed for some cases of sterility in the domestic animals. However, to date this has been definitely proved only in laboratory animals. The average daily ration of a bull should contain normal requirements of this vitamin but it could be deficient since the amount in the same kind of feed can vary a great deal. The other vitamins may be interrelated in producing lowered fertility of the bull.

Senile Sterility

A temporary sterility occurs in old bulls which have been moved to a new environment. Although the exact cause is not known, change in habits, feed and climate have been incriminated. In most of these cases, the fertility returns in a few weeks as the bull becomes accustomed to the new surroundings.

Senile sterility occurs in bulls as in males of other species. The onset may be hastened by the addition of one or more of the above etiological factors. Predisposing factors to sterility in bulls are very important. Calthood diseases, poor nutrition during the calthood growing period and genital unsoundness of the dam and sire are important predisposing factors. Using a young bull too early in life may ruin him for later use as a sire. The age at which it is safe to start using a young bull depends upon the growth rate and nutrition during calthood. The safe age for most breeds is from 9 to 12 months. The number of cows served by the bull during the first year should be limited.

If the bull runs with the cows, he should not have over 40 to 50 cows to breed per year. If hand breeding is used, the number may be from 60 to 90 cows per year. Bulls used in artificial insemination rings should be placed on a regular schedule, the interval between each semen collection depending upon its quality.

Tentative Diagnosis

The tentative diagnosis of sterility in the herd bull is usually made on the history of the cows in a herd not conceiving when bred to a certain sire. The owner sooner or later notices this existing condition and calls upon the veterinarian to effect some remedy. Only in rare instances, as in artificial insemination associations and in valuable purebred herds, are complete records of the herd available to aid the practitioner. Therefore, with so little information from the owner, the diagnosis must be made more complete as to the possible causes of the existing sterility on the basis of clinical findings and laboratory tests. Differential diagnosis is not always possible since a combination of factors may be present; yet no specific clinical manifestations of any one of the factors is present to aid in making the differentiation. Laboratory tests plus temporary experimental treatment are then resorted to in an effort to establish or eliminate a few of the possible etiological factors.

Nutritional Factors

The establishment of nutritional factors as the cause of a case of sterility is usually quite difficult. Examination of the ration may reveal an unbalanced diet which indicates possibility of a nutritional disorder as the cause, but the herd history, plus clinical symptoms of the nutritional deficiency present in other members of the herd, gives further indication of the cause. Diagnosis of Vitamin C deficiency as the etiological factor can be made by laboratory tests to determine the level of ascorbic acid in the blood and semen of the affected animal. The normal readings are given by Phillips² as 0.2 to 0.4 mg. of

ascorbic acid per 100 cc. of blood plasma and 3.0 to 7.0 mg. per 100 cc. of semen.

Among the laboratory tests are the colorimetric type using such dyes as dichlorobenzeneindophenol which are only reduced, and thus decolorized, by such readily oxidized chemicals as ascorbic acid. The normality of the dye solution decolorized in 10 seconds by the test material serves as an index to the concentration of ascorbic acid. These tests are very delicate and should be made only by one who has the competence and patience necessary to obtain accurate results. In the past, many of the diagnoses of vitamin and other nutritional disturbances as the cause of sterility have come from favorable results obtained in experiments, frequently uncontrolled, with corresponding therapeutic agents.

The influence of heredity cannot be ascertained in a single case of sterility of the herd bull without the complete history from the owner or from records showing a similar condition traceable along one side of the pedigree. The records are usually incomplete; laboratory tests and clinical manifestations are of little aid and the factor of coincidence complicates the problem of diagnosis when one attempts to incriminate heredity as a factor.

Infectious Diseases

Infectious diseases as causes of sterility in the bull are diagnosed from the herd history, clinical symptoms and laboratory tests. Trichomoniasis, though not producing sterility in the bull, will be transmitted from the bull to the cow at coitus, and this by producing genital infection in the cow prevents conception or full-term pregnancy if conception does occur. This condition is recognized by the history of a spreading genital infection in the herd, especially those bred to the suspected bull, and by microscopic examination of the preputial exudate of the infected bull for the causative agent, *Trichomonas bovis*. Positive findings on these smears usually means that the infection is present but negative findings are inconclusive and do not necessarily mean that the condition is not present. In

trichomoniasis of the bull, the sexual desire, ability to copulate and general fertility of the semen are usually not impaired.

Brucellosis as a cause of sterility of the bull is not often encountered. The orchitis may be evidenced by hot painful swelling of the testicles with subsequent hypoplasia and fibrosis. The organism is not often found in the semen of the infected bull, contrary to the usual findings in the infected boar. The agglutination test on the blood of the bull as a part of the brucellosis control program of the herd is a valuable diagnostic agent when done by a federal or state laboratory with standardized antigen.

Tuberculosis

Orchitis due to tuberculosis is not definitely diagnosed until it reaches the post-mortem table of the packing plant. These animals have been slaughtered as reactors to the intradermal tuberculin test. This form of orchitis is becoming a rare condition as a result of the federal eradication program.

The infective organism is usually present in the semen in cases of orchitis due to streptococci.

The most valuable diagnostic procedure in determining the extent of infertility of the bull is the laboratory examination of semen. A very practical method as used by Coffin³ is given below. The laboratory tests are of most value when made often to check the progress of treatment. The laboratory examinations may reveal whether or not the diminished fertility is due to: (1) deficiency in number of spermatozoa, (2) a reduction in vigor of spermatozoa, (3) abnormal forms of spermatozoa or (4) abnormalities of seminal and prostate fluid.

Semen Collection

The semen can be collected from the bull in several ways. The use of the artificial vagina seems to be the method of choice since the quantity of the semen can be measured. The ejaculate is not as subject to contamination and changed

character is in other methods. In the withdrawal of semen from the vagina of cows after copulation, the quantity cannot be measured and the sample is mixed with vaginal debris. Massage of the male accessory sex organs per rectum has been used with some success. The first portion of the ejaculate must be discarded as it is chiefly accessory sex gland secretion and urethral debris. Electrical stimulation in sheep and manual manipulation of the external genitals of poultry and dogs has been used by Lambert and McKenzie⁴ for semen collection.

Examination

The examination of the semen consists of 2 parts, gross examination and microscopic examination. The gross examination consists of determining the quantity, viscosity, color and opacity of the semen. **QUANTITY.** The quantity of semen varies a great deal with the frequency of ejaculations before the sample is taken. The volume should be considered in conjunction with the concentration in determining the total number of spermatozoa per ejaculate. The normal quantity of semen per ejaculate is 3 to 8 cc., the average being 4 cc.

VISCOSITY. The viscosity is graded as thick, normal and thin, and depends upon the period of collection as well as the animal. It is determined by stretching a portion between the thumb and index finger. The viscosity in good quality semen should be normal to thick.

COLOR. Normal semen is milky, or milky with colorless portions. The presence of pus or urine will give evident variations.

OPACITY. Opacity is a rough index to the concentration of spermatozoa but microscopic examination is needed for an accurate sperm count and to determine the number of bacteria, epithelial cells, leucocytes and urinary debris present. Improper collection may result in flocculence or abnormal turbidity which is evident on examination.

The microscopic examination of semen includes enumeration or spermatozoa count, motility and morphology of individual stained spermatozoa.

ENUMERATION. The technic of the

spermatozoa count is very similar to that used for blood cell counting. One method will be described here. (a) Fill a red blood cell pipette to the 0.5 or 1.0 mark with semen from a well mixed sample. (b) Dilute to the 101.0 mark with red cell diluting fluid or special fluid consisting of sodium bicarbonate 5 Gm., formalin 1 cc. and distilled water 100 cc. (c) Fill the Neubauer counting chamber and count sperm heads on 4 large corner squares and the entire central square. (d) In the calculations, the total of 5 squares times 2 equals the number of sperm per cmm. of diluted fluid. The next multiplication factor varies as follows: 100 if pipette is filled to 1.0 mark, 200 if pipette is filled to 0.5 mark and 20 if white is used. This gives the number of spermatozoa per cmm. of semen which should equal 300,000 to 2,000,000 in the bull with an average of 800,000 per cmm.

MOTILITY. The examination for motility includes (1) the degree of motility, (2) percentage of motile sperm, (3) type of motility and (4) duration of motility. Motility is a characteristic which includes vigor and viability of the sperm. The degree of motility and the percentage of motile sperm are graded in a practical way by Herman and Swanson⁵ as follows:

- 0—no motility discernible.
- 1—less than 50 percent in a weak oscillatory motion.
- 2—more than 50 percent in vigorous rapid motion but no waves or eddies.
- 3—75 to 85 percent motile with vigorous waves and eddies moving slowly.
- 4—90 percent motile with rapid waves and eddies.
- 5—100 percent motile, waves and eddies extremely rapid.

Spermatozoa must have a percentage motility of 90 or above to be considered satisfactory. The types of motility with gradation from lowered to high fertility are: (1) oscillatory or stationary bunting of individual sperm but no discernible movement, (2) undulating with slow progressive movement, (3) rapid, progressive, vibrating movement discernible under lower magnification. In bulls the duration of motility is related to potency. The

duration of motility varies inversely with the temperature until at 40° to 50°F. the motility decreases with further temperature drop.

MORPHOLOGY. The presence of a high percentage of abnormal morphological forms of the spermatozoa has been associated with low fertility. The procedure in proper staining of these cells is herein outlined. (a) Prepare a thin smear on a clean slide and fix by air and heat. (b) Add 1 percent chloramine to remove excess mucus. (c) Wash with water, then 95 percent alcohol and blot dry with paper. (d) Stain 2 to 5 minutes with stain composed of Ziehl-Neelson's carbol fuchsin 2 parts, concentrated alcoholic solution of eosin 1 part and 95 percent alcohol 1 part. (e) Wash with water and counterstain with Loeffler's methylene blue, then wash again with water. The heads of the spermatozoa stain purple; the tails and middle pieces pink or red. Abnormalities to be observed are coiled tails, pyriform heads, swollen heads, double heads, double tails, beaded middle pieces and the presence of bacteria, cellular debris, leucocytes and erythrocytes. The number of abnormally formed spermatozoa should not exceed 16 percent.

The results of the entire laboratory examination should be summarized. Logical conclusions as to the quality of the semen can be made following a series of these examinations.

Treatment

As regards treatment and prognosis, sterile bulls may be divided into 3 general groups: (1) Those which are hopelessly sterile, (2) those which are able to copulate but have a lowered fertility, and (3) those bulls which possess healthy sperm but are incapable of copulating.

The prognosis of the first group with regard to favorable response to treatment is self-evident. If the veterinarian recognizes that a certain case of sterility falls into this group, he should inform the owner of the prognosis and recommend the animal's slaughter.

The second group presents the more difficult problem to the practitioner. The

most important measure in treatment of this type is genital rest combined with exercise and a balanced ration. A favorable influence on the fertility of the animal should be effected within a few weeks. Obese animals should have fattening feeds reduced and be given plenty of exercise. Many devices for exercise have been used for bulls. Treadmills and electric exercisers have been used quite successfully. Exercise is not a problem for the bull which is allowed to run with the herd. Thyroid extracts have been used to increase the metabolism of some obese, slow-breeding bulls. If indicated from the results of the diagnostic tests, vitamin therapy may be resorted to. Vitamin C blood levels may be raised by the use of ascorbic acid intravenously or using chlorbutanol per os at the rate of 3 to 5 Gm. b.i.d. The toxicity in overdosage of the latter must be watched for.

Hormone Therapy

Hormonal therapy has been used with a variance of results. Anterior pituitary and anterior pituitary-like hormones have been used with success in a few cases. No rational therapy with these products can be attempted by the practitioner until the exact role of hormones in sterility of the bull is determined. The interrelationship of the endocrine glands is so complex that one could not hope to get results in all cases of sterility by the use of one hormone product.

Debilitated and emaciated animals must be nourished by a well-balanced ration supplemented with vitamin and mineral products. In all cases of treatment of this type, the examination of the semen of the bull must be done at regular intervals to mark the progress of treatment in determining when the bull shall be fit to return to service.

The third form presents a different type of problem with regard to treatment. In some cases the semen may be obtained from the bull with the aid of an artificial vagina or by rectal massage and used to impregnate cows by means of artificial insemination. In other cases, the condition may never be corrected, as in arthritis,

extensive foot-rot or fractures and deformities of the bones. Routine wound treatment may be used on traumatic wounds of the penis and prepuce. Orchitis due to brucellosis has no specific treatment. The animal is immediately allowed genital rest and must be disposed of as a reacting member of the herd if under the federal test and slaughter program for brucellosis eradication. The infective organism is usually not transmitted through the semen in the bovine but the infected bull should be used only on infected cows if at all. Penicillin B, one of the new antibiotics, may be used with value in treating brucellosis in the future. The vaccination of calves with *Brucella abortus* strain 19 may be of some value as a preventive measure along with isolation from adult cows and from other species. Any addition to the herd should be tested before admittance.

As previously stated, trichomoniasis does not produce a true sterility in the bull. The effects of this condition are balanitis in the male and uterine infection resulting in abortion, pyometra and sterility in the cow. The infective agent may be transmitted from male to female and vice versa during the act of copulation, so again the first measure in treatment should be isolation of the infected animals from the herd and complete genital rest until the infection is warded off. This usually is accomplished by 6 months of genital rest. Astringent antiseptics may be used on the balanitis during this interim of sexual rest and isolation. The infected cows would also have to be isolated and placed in genital rest and a non-infected bull used on the rest of the herd. The pyometra and sterility of the cow would be treated.

Reactors Eliminated

Orchitis due to *Mycobacterium tuberculosis* is not treated where the intradermal tuberculin test is positive, for that animal must be disposed of as a tuberculin reactor.

Prevention rather than cure is of most benefit in cases of sterility. A balanced ration, freedom from calthood sicknesses,

exercise, regulated sexual work and general sanitation are the most important preventive measures to be made effective by a herdsman who is conscious of their value in maintaining the sexual health of the bull and the entire herd.

REFERENCES

1. Lagerlof, B. T. 1936. Sterility in bulls. *Vet. Record*. 48:1159-1171.
2. Phillips, Paul H. 1940. Directions for ascorbic acid therapy of slow-breeding bulls. *J. A. V. M. A.* 97:165-166.
3. Coffin, David L. *Manual of Veterinary Clinical Pathology*. College Offset Press. Univ. of Penn. 1944.
4. Lambert, N. V. and McKenzie, F. F. 1940. Artificial insemination in livestock breeding. *Bul.* 567 U.S.D.A.
5. Herman, H. A. and Swanson, W. W. 1941. Variations in dairy bull semen with respect to its use in artificial insemination. *Agr. Exp. Sta., College of Agr., Univ. of Missouri*.
6. Fincher, M. G., Olafson, P. and Ferguson, J. 1942. Sterility in bulls. *Cornell Vet.* 32:407.
7. Anthony, D. J. and McGaughey, J. 1935. Testicular tuberculosis as a cause of sterility. *Vet. Record*. 15:860.

Enrollment Statistics In The Veterinary Division

The effect of the war is reflected in the diminished enrollment in the Division of Veterinary Medicine at Iowa State College. The 59 graduating seniors will leave 126 students enrolled in the division.

The Army has succeeded in commissioning a sufficient number of veterinarians to fill the quota of the Veterinary Corps. With the purpose of veterinary A.S.T. fulfilled, the sophomore and junior A.S.T. students were given the choice of an honorable discharge or assignment into a combat unit. About 85 of those affected by the order elected to remain in school with a military deferment on the basis of education for an essential occupation.

The 56 remaining juniors have yet to complete the last quarter of the third year, so no senior class will be in attendance for that period. The sophomore class, with an enrollment of 34, will complete the second year of work in December.

Twenty-six freshmen started professional studies during the summer quarter. Of these men, 12 are from Iowa, 4 from Minnesota, 3 from Wisconsin, 2 from Panama and 1 each from Idaho, South Dakota, Nebraska and Illinois.