
Vasectomy as a method of Sterilizing Ram Lambs.

A Comparison with Castration.

**By J. QUINLAN, M.R.C.V.S., Dr.Med.Vet.,
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THE idea that vasectomizing the male animals instead of castrating them might be of considerable economic value to farmers, was first suggested to the Director of Veterinary Education and Research in 1923, by Dr. Robertson of Mossel Bay, C.P. Figures giving the supposed economic gain to farmers, if vasectomy were generally adopted instead of castration as a means of sterilization in male animals, were suggested by Dr. Robertson. As no evidence was available as to the relative value of vasectomy over castration it was decided to test Dr. Robertson's views. From the beginning it must be pointed out that Dr. Robertson's views on castration of male animals are not those generally held by people in the best position to judge. In the correspondence with the Director of Veterinary Education and Research, Dr. Robertson appeared to be under the impression that removal of the testicles in the lower animals had the same physical and mental significance as in humans. This, however, is not so. It is agreed that animals from which the testicles are removed become docile and fail to develop the secondary sexual characters of the male. Such a condition is, naturally, desirable in horses and cattle which must be worked together or run on the same farm with females of the same species. The development of secondary sexual characters, of which the abeyance of sexual desire is the most important in so far as the maintenance of animals under farm conditions is concerned, is immediately checked by removal of the gonads in the male, or by causing their atrophy by interference with the blood supply, such as is done by some methods of castration. Another secondary characteristic of male equines and bovines, which must be controlled in some way, is the vicious tendency that is developed in many animals so that they become a danger to their fellows or even to man. The presence of one vicious bull or one vicious stallion on a farm is most undesirable. It is not difficult to imagine what a state of chaos would exist in a troop of equines behaving like stallions, or a herd of bovines behaving like bulls. Naturally such a state of things could not be allowed to exist. In the case of sheep the development of the normal sexual desire, associated with rams, would not have such an awe-inspiring effect as in bovines or equines, provided they could be kept in a properly fenced camp. The experience gained during the conduction of these experiments, clearly points out that it is extremely difficult to keep a group of sheep with the secondary sexual characters of rams always under control without jackal-proof camps.

It would be an advantage which must not be lost sight of in the sterilization of male animals, if the full development of the skeleton

could be maintained. It is well known that the removal of the testicles somewhat retards full skeletal development. When castrated animals reach maturity and are ready for slaughter they cannot compare in size and weight with males of the same species, so that in the case of bovines removal of the testicles no doubt causes a loss in beef and hide. In the case of sheep there is loss in mutton, and it requires no explanation to imagine the advantage of a big framed ram over a wether in wool production. In the case of equines castration appears to give entire satisfaction. It does not reduce stamina. Most of the best steeple-chasers in England are gelded. Relatively few mares and stallions have won such a race as the Grand National Steeplechase of four and a half miles, which is without doubt the greatest test of equine stamina imaginable.

From a practical standpoint to the farmer in any method of sterilization of male animals which are used as human food, the following are a necessity:—

1. Sterilization of undesirable male animals so that the danger of reproduction is removed.
2. Removal of sexual desire and certain associated conditions such as coarse and characteristically odoured flesh in male bovines and rams at the time of slaughter.
3. Removal of vicious tendency in certain male animals.

In attaining these objects the following points should be considered:—

1. Maximum growth, endurance and vitality.
2. As a sequence to 1, maximum weight at the time of slaughter and maximum production of the most saleable variety of wool in sheep.

Prior to the present series of experiments no consideration has been given to the possible economic value of vasectomy in the lower animals. It is doubtful if the operation was performed in South Africa prior to these experiments being undertaken. It has been used as a means of creating "teasers" in studs where the utmost economy is desirable with highly valuable stallions. These "teasers" are used to try mares for oestrus prior to service.

It was performed as a means of castration in countries where opening of the scrotum was undesirable on account of the danger of infection with fly larvae but was not considered as an economic possibility. The more recent methods of bloodless castration are to be preferred.

Within recent years it has been used as a means of rejuvenation in humans by Steinach. Steinach⁽¹⁾ and Ancel and Bouin⁽²⁾ maintain that ligature or section of the vasa deferentia causes an atrophy of the reproductive cells of the male gonads. As a consequence there is an increase in the interstitial cells of the testicles, the internal secretion of which is responsible for the development of the secondary characters of the male. His experiments on rejuvenation are based on this physiological phenomenon. That the physiological phenomena ascribed by Steinach to the interstitial cells in the testicles are not

(1) Steinach, E.; Cit. Walker. *Feminierung von Männchen und Maskulierung von Weibchen*. *Lancet*, No. 5236, Vol. CCVI, 1924, p. 18.

(2) Ancel and Bouin: Cit. Walker. *Recherche sur le rôle de la glande, interstitielle du testicule*, *Comptes rendus de l'Académie des Sciences*, December, 1903. *Lancet*, No. 5236 Vol. CCVI, 1924, p. 18.

altogether beyond controversy is well known. Walker⁽³⁾ draws attention to the possible errors in this supposition. Some well-known physiologists maintain that the cells of Sertoli in the tubules of the parenchyma of the gland also play an important rôle.

THE OPERATION.

The operation of vasectomy in lambs is simple and can be carried out expeditiously. After a little practice it is possible to vasectomise 20 to 25 lambs an hour and have 100 per cent. successful results. The most convenient time to operate is when the testicles are fairly well developed, at about two months old. It is of course possible to operate on much younger lambs without difficulty but it appears to possess no advantage and is considerably more difficult than at the age of two to three months. The scrotum should be clipped clean of wool. The writer takes the further precaution of shaving the posterior surface of the sac. This is not absolutely necessary, but in all operations where success depends on absolute asepsis no precaution can be considered superfluous. The lambs are prepared the day previous to the operation so that no time is lost on the day of operation.

Vasectomizing lambs is extremely monotonous work and any one but a person extremely interested is likely after completing 100 lambs to abandon strict aseptic precaution, so that many of the subsequent operation wounds become septic, to be followed by septic periorchitis with adhesion of the testicle to the sac and atrophy of the testicle.

The instruments required are:—

1. Small ball-edged scalpel to incise the scrotal sac.
2. Small blunt hook to pick up the vas deferens.
3. Small round curved needle to suture the wound.
4. Two small artery-forceps.
5. No. 4 catgut, 12 day, or suture silk.
6. Collodion and iodoform in dusting tin or insufflator.
7. Small table to be used as an operating table.
8. Sterilizer for instruments.
9. Ether.
10. Cotton wool.
11. Disinfectant for hands.—Corrosive sublimate (1-1,000 in spirits).

The lamb is placed in the dorsal position on the table and held by two assistants. The hind limbs are drawn well forward so as to expose the scrotum as much as possible. No anaesthesia is necessary. The sac is thoroughly washed off with a swab of cotton wool which has been moistened with ether. The hands are sterilized by first thoroughly washing with soap and hot water, and then washing off with the corrosive sublimate and spirits solution. The instruments are used direct from the sterilizer. The scrotum is taken in the left hand and one testicle drawn to the bottom of the sac so that the cord can be easily felt towards the neck of the sac. The vas deferens is then sought for and is easily found by its characteristic cord-like "feel." It is separated from the body of the cord by the forefinger and thumb of the left hand. The remaining fingers of the left hand are now pressed against the anterior surface of the neck of the scrotum so that the vas deferens can easily be felt pressed against the skin of the

(3) Walker, K. M.: The Internal Secretion of the Testis. *Lancet*, No. 5236, Vol. CCVI. 1924, pp. 16-21.

posterior aspect of the scrotum. A short incision about $\frac{1}{2}$ inch is now made through the skin on the posterior aspect of the neck of the sac parallel to its long axis immediately over the isolated vas deferens. It is necessary to incise the tunica vaginalis as well as the skin. When the incision is complete the vas frequently protrudes from the wound. If the vas does not protrude it is picked up and withdrawn with the small blunt hook. It is then caught up in an artery forceps and about $\frac{1}{2}$ an inch removed with the scissors. It retreats immediately into the tunica vaginalis. The operation is completed by putting one catgut suture in the skin wound. The second vas deferens is treated in the same way. The wounds are closed with an iodoform and-collodion protective seal. In the case of very fat lambs some difficulty will be experienced by the fat protruding through the skin wound after the incision has been completed. This, however, can be removed with the scissors. When the skin is sutured with catgut no after treatment is necessary. If silk sutures are used they should be removed on the 6th or 7th day. The lambs suffer no inconvenience from the operation.

As a result of the operation there is a definite progressive change in the appearance of the testicle. For the first twelve months after vasectomy the testicle grows normally in size and shape. It is of equal weight to the testicle of a ram of the same breed, age and size. On section it is not possible to differentiate it from the testicle of a ram. There is a gradual enlargement of the tail of the epididymis which at the end of twelve months reaches the size of a walnut or somewhat larger. This enlargement is due to accumulation of debris.

During the succeeding twelve to fifteen months the change in the appearance of the testicle is more rapid. It is possible to differentiate between a vasectomized sheep and a ram by looking at the scrotum which shows an enlargement towards the base due to the swollen tail of the epididymis. About two years after vasectomy the tail of the epididymis is greatly enlarged, up to about a third of the size of the testicle (Fig. XVI). It forms a thin-walled fluctuating sac which is filled with yellowish thick-liquid debris. There is a distinct constriction between it and the testicle. The testicle has undergone reduction in size and has become somewhat rounded. It is softer and more flabby than the testicle of a normal ram. On section it is not changed in colour but appears unusually moist. It is yet too early to make a definite statement, but it appears that the testicle is undergoing gradual hypoplasia.

On microscopic examination of the debris taken from the tail of the epididymis it is found to be composed of a structureless mass which shows apparent commencing calcification in places. Degenerating spermatozoa heads can be seen. The wall of the sac is composed of a very thin layer of connective tissue. The epithelial cells have undergone degeneration. In places they are entirely absent, in other places degenerated epithelial cells can still be seen. Twelve months after vasectomy sections of the testicles of a vasectomized sheep could not be differentiated from those of a ram. spermatogenesis was still quite evident, and there was no increase in the interstitial tissue. Two and a half years after vasectomy spermatogenesis was still apparent in sections from the testicles of the vasectomized sheep. The reproductive cells lining the tubules, however, appeared somewhat less dense than in the ram. Some of the germinal epithelial cells may have undergone disintegration. Hum-

phrey (4) mentions that vasoligation in a goat for a period of eighteen months did not produce any disturbance of spermatogenesis or hypertrophy of the interstitial cells of the testis. In a ram eight months after operation one testicle was unchanged while in the other the germinal epithelium was reduced and spermatogenesis was in abeyance. There was no hypertrophy of the interstitial tissue. Both the experimental animals were believed to have shown increased *libido sexualis* as compared with normal controls.

THE EXPERIMENT.

In September, 1923, a few sheep were vasectomized to ascertain if the expense of carrying out an experiment on a large scale would be justified. This limited experiment which was terminated after the sheep had been under observation for a period of twelve months indicated that there were certain economic possibilities which would justify further expense in experimental investigation.

A fairly extensive experiment was begun on the farm Bestersput, in the Free State in October, 1924. In planning the experiment it was decided to run the sheep under the natural veld conditions prevailing in the Free State.

The objects aimed at were as follows:—

1. To ascertain the value of vasectomy compared with castration as a practical method of sterilizing male sheep.
2. To ascertain the influence of vasectomy on the secondary male characters.
3. To ascertain the influence of vasectomy on the skeletal development of sheep.
4. To ascertain the influence of vasectomy on mutton production.
5. To ascertain the influence of vasectomy on the growth and character of wool.

To obtain the best results in such an experiment it is desirable that a purely mutton type and a purely wool type of sheep should be used. Owing to the expense entailed, such an absolute division in type was not possible. The sheep were mostly selected from a mixed flock of lambs maintained on the Government farm at Bestersput. The sheep appeared to be the product of original Afrikaner mothers and a weak type of merino ram. They were of the first, second and third generation. The lambs were selected from the flock at the age of two to four months. Those which showed an appearance of predominant merino were put in the wool production experiment, and those showing Afrikaner predominance were selected for the mutton production experiment. The whole flock was used for observation on general and secondary sexual characters as stated under headings 1, 2, 3, and 4.

The experiments were divided as follows:—

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| <p>A. Mutton type with Afrikaner predominance.</p> <ol style="list-style-type: none"> 1. Vasectomized (37). 2. Control rams (25). 3. Control wethers (25). 4. Control ewes (40). | <p>B. Wool type with Merino predominance.</p> <ol style="list-style-type: none"> 1. Vasectomized (44). 2. Control wethers (26). 3. Control ewes (30). |
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(4) Humphrey, R. R. Effects of Vasoligation in Sheep and Goat. *Anat. Rec.* 33 (1) 41-46. 1926. Abst. from Biological Abstracts. Vol. I., No. 1., p. 64. December, 1926.

The experiment was begun on October 10th, 1924. All the sheep were placed under as similar conditions as it was possible to place them on the farm Bestersput, Petrusburg District, Free State. The rams, wethers and vasectomized lambs were run together, while the ewes were run in a flock apart, but in a camp in which veld conditions differed little from that which maintained the other flock.

Each sheep was weighed at monthly intervals. They were shorn at the termination of twelve months and two years observation, and records kept of the weight, length of staple, and character of the wool. The observation has now been continued over a period of more than two years and the details which follow in tables I and II show the result. Observations of the deaths in each flock have also been made to ascertain if any flock showed more or less resistance to natural veld conditions and diseases.

It will be noticed in the tables and graphs that there was a decrease in weight during the later winter months of 1925 and 1926. In consequence the highest average weight attained in each flock is given in addition to the average at the end of the period of observation.

During the winter of 1925 an unusual drought was experienced at Bestersput, and "steek gras" (*Heteropogon contortus* and *Aristida congesta*) was unusually plentiful so that the flock suffered considerably from privation. They were maintained solely on the veld. No concentrate was fed. During the winter of 1926 the sheep received an additional ration of 1 pound of lucerne hay per day. This was fed from sheep racks and was eagerly consumed.

The flock was dosed at monthly intervals with "Government Wireworm Remedy" and always had access to a bone-meal and salt lick.

The sheep remained free from wireworm infection, but occasional post-mortems showed there was a fairly extensive *oesophagostomum columbianum* infection.

Some of the vasectomized sheep were slaughtered to test the nature of the mutton. It was extremely good but had a slight flavour of ram mutton.

In order to avoid false conclusions from the tables and graphs there are certain points which will require explanation. In the experiment B it will be noted that there are no control rams, but this was unavoidable since attempts made to purchase suitable lambs at the time were unsuccessful. The 26 wether controls in experiment B were purchased from a neighbouring farm. They were practically of equal weight and a somewhat better wool type than those bred at Bestersput. This accounts for the apparent increase in wool production. Their improvement over the two years was most disappointing. This was no doubt due to a bad wireworm (*Haemonchus contortus*) and nodular worm (*oesophagostomum columbianum*) infestation before purchase from which they failed to recover completely. The results obtained in experiment A are convincing as all the lambs were from Bestersput flock.

During the course of the experiment the ewes maintained a much better condition than the rams, wethers or vasectomized sheep. This is no doubt due to a bad wireworm (*Haemonchus contortus*) infestation of the ewes is probably due to their docility. The rams and vasectomized sheep were very restless and considerable fighting took place daily among the flock.

TABLE I.
Merino Type.

	No. when Experiment Began. (10.10.24.)	No. at End of First Year.	Average Weight of Sheep at End of First Year.		Average Increase of Weight, First Year.		Average Weight of Wool, First Year.		Average Length of Wool, First Year.		No. of Sheep beginning of Second Year.		No. at End of Second Year.		Average Weight of each Sheep at End of Second Year.		Average Increase in Weight, Second Year.		Average Weight of Wool, Second Year.		Average Length of Wool Second Year.		Total Average Increase for Two Years.		Average Weight of Wool in Two Years.		Highest Average Weight Obtained.	
			lb.	lb.	lb.	Inches.			lb.	lb.	lb.	Inches.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.								
Ewes.....	30	29	58.5	28.0	5.5	2.56	29	26	73.0	15.4	5.08	2.17	43.4	10.58	81.9													
Wethers.....	26	23	51.69	12.39	6.5	2.8	23	22	62.06	10.37	6.18	2.2	22.76	12.68	63.63													
Vasectomized.....	44	36	65.22	27.62	5.86	2.65	36	30	79.8	14.58	6.2	2.5	42.2	12.06	96.15													

TABLE II.
Mutton Type (Bastard and Bastard Merino).

Wethers.....	25	23	64.0	25.0	5.0	2.75	23	21	82.2	18.2	5.4	2.13	48.2	10.4	99.8
Rams.....	25	22	60.0	30.5	3.19	2.25	22	21	80.8	20.8	4.1	2.15	51.3	7.29	97
Ewes.....	40	37	68.0	26.7	5.13	2.68	37	35	74.01	6.01	3.44	2.08	32.71	8.57	88.9
Vasectomized.....	37	33	72.0	32.0	4.62	2.5	33	29	77.5	5.5	4.2	2.07	37.5	8.82	100.05

In experiment A where the observations are confined to a mutton type of sheep with Afrikander predominance it will be observed on consulting table II that the vasectomized sheep were heavier at the end of the first year than the ewes, rams and wether controls. Their average weight exceeded the ewes by 4 lb., the rams by 12 lb., and the wethers by 8 lb. However, during the year their average increase in weight was 7 lb. more than the wethers, 1.5 lb. more than the rams, and 5.3 lb. more than the ewe controls.

It would not be of much use estimating the wool production from this type of sheep, but as the statistics as to the weight and length of staple of the wool are available they are given in the table.

At the end of the second year the average weights of the 4 groups of sheep in this experiment had altered. The vasectomized sheep were 4.7 lb. lighter than the wethers, 3.3 lb. lighter than the rams, and 3.5 lb. heavier than the ewes. The vasectomized sheep, however, show a lower average increase than the controls at the end of the second year.

Owing to the circumstances already referred to it is considered more important to give the highest average weight of the sheep in each group. The ewes and wethers kept much better condition throughout the winter, and on that account their average weights approach close to the rams and vasectomized lots. Had the rams and vasectomized sheep been in the same condition they would have averaged considerably more. The difference in condition is attributed to the restless tendency at pasture of the rams and vasectomized sheep. The vasectomized sheep reached a highest average weight of 100.05 lb., 11.15 lb. higher than the ewes, 2.15 lb. higher than the rams, and 9.25 lb. higher than the wethers.

The total average weight of wool produced in two years is also given in the table; but it must again be emphasized that as the sheep in experiment A were picked for mutton rather than wool, this is of no value.

In experiment B where the observations are confined to a wool type of sheep with merino predominance it will be observed in consulting table I that at the end of the first year the vasectomized sheep were 13.53 lb. heavier than the wethers and 6.72 lb. heavier than the ewe controls. They yielded an average of .36 lb. of wool more than the ewes, but .64 lb. less than the wethers. It has already been explained that the wether controls were of a better wool type, but they did not do well during the period under observation. This would account for the slightly better yield of wool and at least some of the great difference in weight.

At the end of the second year the vasectomized sheep had not only maintained but had increased the difference in the average weight when compared with the wethers. They were 17.8 lb. heavier than the wethers and 5.9 lb. heavier than the ewes. The vasectomized lot produced an average of 12.06 lb. of wool in two years against 12.68 lb. by the wethers, and 10.58 lb. by the ewe controls. Regarding the length of staple the vasectomized sheep also showed the highest average, namely 2.5 inches against 2.2 inches by the wethers and 2.17 inches by the ewe controls.

The highest average weight during the two years is also shown by the vasectomized sheep. They reached 96.15 lb., which was 27.52 lb. higher than the wethers highest average, and 14.25 lb. higher than the control ewes highest average. Here again it must be emphasized that the wether controls used in experiment B were a purer merino

type than the ewes and vasectomized sheep. There would therefore be a tendency to produce more wool, which they actually did although they did not maintain a proportional increase in body weight.

Conclusion :

1. Vasectomized sheep are sterile.
2. Vasectomized sheep, even when the operation is carried out at an early age, develop the secondary sexual characters of rams.
3. Vasectomized sheep maintain a greater weight than wethers or ewes when fully mature, and in this respect are equal to rams.
4. The flesh of vasectomized sheep has the characteristic taste of "ram mutton." (This could be overcome by castration six months prior to presenting for slaughter. An experiment to ascertain the effects of castration on vasectomized sheep at the end of the second year is now in progress.)
5. Vasectomized sheep produce more weight of wool than wethers and ewes, and in this respect are equal to rams.
6. The quality of the wool produced is similar to that produced by rams.
7. Vasectomy appears to have little effect on the endurance and vitality of the sheep when run under natural veld conditions. They were as equally susceptible to disease as the controls.
8. Vasectomy has a certain economic aspect in as much as it allows greater skeletal development, thereby providing for more mutton and wool. When the skeletal development is attained the sheep could be castrated. (Aged sheep do not stand ordinary methods of castration without great shock. The use of the Burdizzo pinchers, however, would prevent this sequel.) (An experiment has been carried out to test the effects of castration with Burdizzo pinchers on two years old vasectomized sheep and rams and it has been entirely successful.)
9. That the restlessness and pugnacious temperament of rams and vasectomized sheep play a part in the putting on of flesh and the maintenance of condition. They do not appear to reach the highly fleshed condition of ewes. When kept under natural veld conditions, without an additional winter ration, they lose condition more rapidly than the placid ewes and wethers.
10. That spermatogenesis takes place at twelve months and up to two and a half years after vasectomy.
11. That there was little or no apparent hypertrophy of the interstitial tissue in sections made twelve months and thirty months after vasectomy.