THE HISTORY OF BOVINE PENILE SURGERY

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I wish to thank the Society for the honor of presenting the David Bartlett paper. Dave is a personal friend. I remember spending time with him in Venezuela where we were teaching postgraduate courses at the University of Maracay. He was conducting a class on the preservation of semen and I was doing one on reproductive surgery.

It was a very interesting time for me because I was able to become very close to one of the great men of our specialty who invented the term "theriogenology" that binds all of us together. That was twenty years ago when we were considered experts in our fields. Now we are just historians. It is natural then that I have chosen the history of bovine penile surgery as my topic.

I was present at the original meeting of the Society For the Study of Breeding Soundness of Bulls at the Northern Hotel in Fort Collins, Colorado. The meeting was conducted by Harold Hill and we organized for the purpose of collecting material and disseminating it when time permitted and the spirit moved. As you all know this material provided the basis for the beginning of semen evaluation or bull evaluation. I personally preferred the term bull evaluation because we soon discovered that we were culling more bulls for physical abnormalities than we were for unsatisfactory semen quality.

It is my forty-something association with penile and breeding problems that makes me feel qualified to relate this history. This will not be a scientific address attesting to the latest techniques and philosophies of penile surgery. I will leave that to you outstanding young men in our institutions and practices that are still actively involved and moving forward, not like the static position of retirement.

Bull evaluation had its impetus as a result of the blizzard of '49 that swept the west and midwest. Throughout the sandhills and ranch country of Nebraska where I practiced from Broken Bow, as well as Wyoming, South Dakota and Colorado, ranchers became concerned when they noticed the frozen scrotums on their bulls. This fear became more acute following an article published in THE OMAHA WORLD HERALD and subsequently picked up by other newspapers in the area. The article promoted the idea that many of the bulls might be sterile. The ranchers and farmers turned to their veterinarians with the question. We were at a loss to answer with
any degree of certainty unless we could get a sample of semen and
examine it.

It was difficult to get a sample of semen at that time. I
remember my first attempt. I secured the services of an artificial
inseminator named Rand Vandervoort who was working out of my office
at Grassland Hospital. We went to a ranch, found a couple of cows
in heat, tied them between four posts and turned the bulls in, one
or two at a time. There were a hundred and twenty-five of them.
Rand had worked primarily with dairy bulls and was quite
apprehensive about these Herefords and Angus.

It turned out to be quite a circus but the outcome was better
than I had expected. There were about 20 bulls that would not
approach the cows. If we got semen and it showed motion under the
scope, I passed the bull. Not a very satisfactory criterion, I
realized.

Many other practitioners had similar experiences. Red Von
Tour of Alliance was one in particular. We expressed our concern
to Harold Hill of Colorado State and found that he was being
bombarded with the problem. Marden of Colorado State developed the
electro-ejaculator at this same time and the Rocky Mountain Society
was on its way.

Hill established a list of criteria for the evaluation of
semen from original work done by Lagerloff of Sweden. The weight
given to each criterion became adjusted by Hill using information
gathered by Ed Carroll and Lloyd Faulkner of Colorado State who
were working under Harold at the time.

We, the practitioners, began supplying additional reports as
the practice of bull evaluation grew. And grew it did---to
encompass other areas of the United States and the world. The
words Rocky Mountain Society were dropped and we became the Society
for the Study of Breeding Soundness of Bulls. Eventually, as cow
problems became a concern, we dropped the words "of Bulls".

Many others were making great strides in the field such as
Dave Bartlett, Ray Zimjanis at Minnesota, Clyde Bierschwal at
Missouri, Steve Roberts at Cornell, and of course Lloyd Faulkner
and Ed Carroll who followed with generous service after Harold Hill
became less active.

We soon had a specialty on our hands, but this was the
beginning of the Colleges in the Veterinary Medical Association and
we were not satisfied with the term specialists. We knew who we
were but it was difficult to convince the AVMA that we were a group
as distinct as surgeons and rated a status of College. The
crowning glory was the term that Dave Bartlett coined:
Theriogneology.
We no longer had problems with the AVMA but problems developed when we realized that a College must make certain requirements and conduct examinations that were going to eliminate a good many who were practitioners with little chance of meeting the imposed regulations.

Someone, I am not sure who specifically as it could have been any one of several, came up with the obvious that we would become the College of Theriogenology for the ivory tower members, and the Society of Theriogenology for the practicing veterinarians with primary interest in the field. This has served us well over the ensuing years and seems to be a working relationship between theory and practice that others do not have.

In the history of my particular area, penile surgery, one must consider the times. The public demand rose during the forties, fifties and sixties. The value of bulls as individuals became exaggerated with it reaching several hundred thousand dollars. In some cases, it was these highly fitted bulls that seemed prone to the problems that kept them from breeding. Naturally, the demand was high by bull breeders on their veterinarians to restore breeding ability.

Many of the problems were known to exist, but there was only limited knowledge as to their exact etiology, physiology, anatomy or clinical correction. It was to these circumstances as a practitioner in Broken Bow, Nebraska, that I began building a hospital where respectable surgery could be done with hospitalization for the recovery period.

Hematoma of the penis had been observed for many years but not a great deal was known about many of its ramifications. Some used the term "broken penis" which is much more descriptive, but since it is soft tissue, it really does not apply. Eventually, of course, we found it to be a transverse rupture or tearing of the tunica albuginea on the dorsum of the penis at the distal flexure.

I was under the erroneous impression that surgery must be done in order to expect a recovery. Enlightenment, as well as embarrassment, came when one of my clients called me to see a hematoma in one of his bulls. He had had a previous case on which we operated but this bull was to be culled anyway, so his questions were if the bull could be slaughtered and could it be postponed until he was in better condition. I told him I thought he would be all right if just left alone. The client put him in a feed lot with some heifers he was fitting. I happened to be back a couple of months later doing some routine work adjacent to the feed lot and noticed the bull following one of the heifers. Then, much to my surprise, he mounted and entered her as slick as a whistle.
Duane Rice, presently of Lincoln, Nebraska, had joined me as a partner about this time. Duane was much smarter than I was and equally concerned about many of the penile problems we were encountering. Exactly who thought of what in many of the circumstances is impossible to say. But it was great to have a partner with whom I could discuss the problems and possibilities. This same thing blessed me again after moving to Auburn University when I was joined by another one of our greats in a couple of years, Bob Hudson. This was during a time when there were few restrictions on what one could do and almost no worry about malpractice suits.

After the experience with the bull and the heifer, we did not operate on all of the hematomas. In most cases the hematomas were reabsorbed and few complications developed. Complete resorption and healing required about three to four months. This usually meant the loss of an entire breeding season. The worst part of the story was that about 50% experienced recurrence.

In the surgery cases I became a little more exuberant in removing the clot and soon found the typical transverse tear in the tunica albuginea of the penis and began to debride the edges and suture the tear tightly closed. I soon became aware of the dorsal nerve of the penis and carefully avoided it in the process. The rationale was that by closing the tear tightly, the amount of scar tissue would be minimized and the chances of recurrence would be diminished. This proved to be true and remains as one of the chief benefits of surgery—reducing the time that the bull is kept away from the cows.

A complication of hematoma, regardless of whether or not surgery was performed, was that a few of the bulls were unable to copulate because the penis was not entering the vulva. This was terribly frustrating to us and the bulls, as well. By closely observing the breeding act, it was noted that the penis would actually enter the vulva but there was no breeding lunge following, as one would expect. It was as if the bull could not feel the vulva. A light turned on and the mystery began to clear. The dorsal nerve was being damaged during the resolution of the hematoma and the subsequent extension of the penis.

To prove our suspicions we took a normal bull and desensitized the glands of the penis with direct nerve block, and on another bull we simply covered the free portion of the penis with butyn. When the bulls were turned to the cows in heat, the same problem existed and they were unable to breed. After allowing some time to elapse and the analgesic agent to dissipate, the bulls were able to copulate properly.

The dorsal nerve of the penis is quite tortuous all along the dorsum of the penis so as to accommodate the 25% increase in length
during erection without damaging the nerve. Following the hematoma, the deep tunic of the fascial layers of the prepuce which carries the dorsal nerve might become adhered to the tunica albuginea, or this may be the neural sheath itself. Under these conditions the nerve loses its ability to stretch and then tears on extreme erection. This is more likely to be the reason than direct damage to the nerve at the time the hematoma occurred. Many cases are on record of bulls successfully breeding a few times after a hematoma, then suddenly exhibiting the classic signs of desensitization.

A test for desensitization can be made by manually extending the penis and applying an electric stimulator to the distal end of the penis. A hot-shot sounds very crude but it is very effective. The owner is also convinced when he sees you apply the hot-shot and there is no reaction from the bull. To my knowledge no one has attempted repair of the torn nerve. To allow a bull sufficient time for regeneration to occur seems very impractical even if good anastomosis could be achieved, considering the length of the nerve trunk.

During the surgical repair of the hematoma, one is impressed with the violent nature of the event. One of my early students, Al Corte of Daphne, Alabama, remarked that it looks as though a hand grenade had gone off. That could not have happened with normal heat induced blood pressure. He decided that he would like to work on the idea as his senior research project.

His methods were simple but effective. He borrowed a physiograph from the physiology department, connected it with a plastic tube to a male attachment that fit into the hub of a 16-gauge needle. The needle was placed into the corpus cavernosum penis in the free portion and an electro-ejaculator was used to produce an erection. The physiograph would only measure up to 300 mm of mercury so on the first attempt the indicator ran off the scale. As a matter of fact, on further attempts the physiograph was ruptured. We were very happy to replace it with a new one.

Now the big question: How was this pressure developed? The fact that the CCP is a closed system and the pressure of erection is produced by the contraction of the ischiocavernosus muscle around the bulb of the penis is now well understood and accepted. It was during this investigation that many other things were found. This work was directed by Dwayne Beckett and assisted by Bob Hudson and me.

The rupturing of the tunica albuginea occurs during the breeding lunge when the penis slips from the vulva and passes into the escutcheon area. The full force of the bull causes the tear on the dorsum of the penis at the distal flexure. At first we thought that the entire hematoma developed at this time, but later we found
that the CCP held only 250-400 cc of blood. The volume of the hematoma was often in excess of one gallon. It then became evident that the size of the hematoma was dependent upon how many successive attempts to breed were made after the rupture. The ischiocavernosus muscle pumps the blood for the intended erection through the rent and into the hematoma.

For some time we thought that there should be a delay before surgery so the hematoma would be well organized. At the present time we feel that if you are going to choose surgery, the sooner it is done the better because a thickened vascular wall develops around the hematoma in the normal repair process that makes surgery more difficult.

When a rupture of the tunica happens under the intense pressure, blood is forced up and down the lamella of the elastic tissue surrounding the penis. The lamella also ruptures and the hematoma increases in size. The peak pressures we measured were in the vicinity of 400 psi, not mm of mercury. This would be about 4000 mm of mercury. The exact workings of the elastic layers remain somewhat of a mystery to me. The deepest layers are probably not associated with the others containing the dorsal nerve and small arteries which are the nutrient suppliers to the penis. These will be dealt with later when discussing shunts. The deepest layers completely surround the penis and ruptures along with the tunica albuginea. The subsequent layers are probably not layers at all, but are folds and invaginations.

My first encounter with deviation of the penis began when a client said that he noticed when his bull attempted copulation, the penis just went into a knot at the end. Then I noted the phenomenon quite often when using the electro-ejaculator. I discussed it with Ed Carroll and he had also noted it on several occasions. Milne, at that time of Colorado State, published a method of correction consisting of cutting a V in the dorsum of the penis.

I tried it in practice and sometimes it worked, sometimes it didn't. On one occasion I became more exuberant in cutting the V in what I thought was the tunica albuginea, and lo and behold, I cut completely through it. That was when I started dissecting the penis of cadavers and my understanding took a giant leap forward. Also, by moving to the University of Auburn, a good library was available and I found I was discovering the Mediterranean Sea over and over again.

Ray Ashdown, an English anatomist who did extensive work on the penis, became my favorite author. He describes the apical ligament I had cut through. He explains the reason it slipped off the dorsum, always to the left, producing the corkscrew effect.
Correction, fixing the apical ligament of the penis to the dorsum and thus preventing the slip, was not as simple as it sounds.

Many things were tried such as simply putting nonabsorbable suture through the apical ligament into the tunica albuginea. This seemed satisfactory for short periods of time until the suture worked itself out, then the deviation would return. Even point fire cautery was tried but with similar results. The final process that was highly successful consisted of planting live tissue from thin strips of the apical ligament into the tunica albuginea. As healing occurred, this became permanent. Some care is necessary so as not to drag small vessels into the corpus cavernosum penis that will result in a shunt.

Two types of deviation occur. The spiral, which we have just described, and the ventral which is the result of a very weak apical ligament that fails to hold the distal end of the penis up during erection. The apical ligament may also split letting a portion go to each side. Surgery is not as successful with ventral deviation as it is with spiral, but the same procedure will work some of the time. Attempts at shortening the apical ligament have not been highly successful but merits further work.

After Bob Hudson and I developed a thorough knowledge of the anatomy and physiology of copulation, we began a system for examining nonbreeding bulls that included a trial breeding attempt. By closely watching and occasionally taking pictures, we were able to determine at what point in the process things were breaking down and to make a diagnosis of the problem.

Once when watching a bull with a preputial erection problem, we noted that erection started but disappeared into flaccidity before intromission could occur. The pulsing of the ischiocavernosus muscle was noted to occur but it seemed as if the blood was simply leaking out—perhaps back through the closure system or elsewhere. The bull had a history of hematoma that had not been operated.

After positioning the bull on the table, we placed a temporary suture between the retractor penis muscle and the penis that acted as a mechanism by which we could pull the penis away from the wall of the abdomen. Then a scout film was taken. A needle was placed into the corpus cavernosum at the distal end with the penis held in extension with a piece of gauze bandage. Flow into the ccp was tested with saline. The ccp was closed by using the electro-ejaculator, then 50 cc of diluted Conray was injected into the ccp. Four serial radiographs were taken. The developed film showed the leak with the Conray going into the venus return at the rupture.

We then proceeded with the surgery and located the leak with the aid of food coloring injected into the ccp as we had injected
the Conray. We removed the vessels that extended through the CCP and sutured the tunica albuginea as we did the hematoma repair. This is now another major reason for doing surgery on hematoma and closing the rent to prevent a shunt.

Many other cases of shunts were found, not all in association with hematomas. To my recollection, shunts were found in most nonerection cases. Once formed, the shunts keep getting worse. They may also develop from the nutrient arteries that penetrate the tunica as very small arteries which are pinched shut with the pressure of the blood entering the corpus cavernosal spaces from the bulb. There is no venous return except on out through the CCP in the normal disorgement route. The blood of erection does not supply nutrition to the penis. It is only an hydraulic fluid. If such shunts are multiple, in my hands they are noncorrectable. When correction is attempted it is necessary to cauterize the small leaking vessels.

Some thought should be given to the simple surgeries that will continue to be important. One of these is papilloma of the penis which occurs in young bulls. Of course, papillomas are noticed more on the neck and shoulder areas where the virus becomes implanted from barbs or other sharp protuberances that scratch them while feeding. Due to the homosexual nature of young bulls, they attempt to mount their partners without paying much attention to which end. The extended penis is rubbed on the warts which causes both the abrasion necessary and supplies the virus as well.

On occasion I am sure all of you have noted that the warts also occur near the tailhead of young bulls. Eventually the body warts tend to disappear, but the warts on the penis stay for some time. They generally become evident after the bull is sold and turned out to breed cows. When the owner sees blood on the prepuce where the warts have been torn by the act of coitus, he calls the seller of the bull who in turn calls you. Diagnosis is made by simply extending the penis.

Correction consists of cutting the wart off gently with a small amount of epithelium around the base. The wound is closed with absorbable suture. A liberal dose of wart vaccine, both subcutaneously and intradermally, should be given. I personally feel that the intradermal injection is the best. If you don’t cut the warts off, many will get covered with epithelium and become a pendulous mass. In most cases they only involve the free portion of the penis. Over enthusiastic surgery has been known to result in analgesia and inability to copulate. Routine preventive vaccination may be indicated in certain herds where warts are a perpetual problem.

Persistent frenulum can be corrected easily, if you so choose. It is a highly heritable condition, primarily observed in Angus and
Shorthorn breeds where the gene apparently originated. It is also seen in their hybrids such as Brangus and Santa Gertrudis. A persistent frenulum is a connection between the prepuce and the ventral part of the free portion of the penis that causes a downward deviation of the penis. Some Brangus and Santa Gertrudis are still able to copulate due to their excessive prepuce. Correction consists of simply clipping the band or bands of tissue.

One of the greatest contributors to preputial surgery was an English female veterinarian, Susie Long, working under Ashdown. As a senior student she noted that some bulls everted their prepuce when at rest. She also noted that these bulls were naturally polled. She did most of her research in the slaughter houses and found these bulls to have a missing or deficient retractor prepuce muscle. The polled characteristic played a definite part. The missing retractor muscle is not always complete and sometimes affects only one muscle. I feel there is some hope that the two factors can be separated by selective breeding.

Another contributing factor to preputial problems is the pendulous sheath of the Brahman breeds. Real problems exist in the polled ones and preputial prolapse is the beginning of most of them. Surgical correction is certainly not the most practical answer in all cases, though it is of prime consideration in bulls with pendulous sheaths and hypertrophy of the prepuce has occurred. Some nasty lacerations will heal with proper, conservative care.

Several techniques of circumcision have developed over the years. Each surgeon has his own preference and as long as it works for him, that is the chief concern.

I have touched on some of the penile and preputial problems that exist and the history of their development and correction. At the present time the concern for these problems is nothing like it was, due to changes in economics and philosophies. Neither situations nor circumstances remain the same, so again we may enter a time of high concern. My chief reason for giving this particular paper is to keep alive and well the past techniques so that those involved will not have to discover the Mediterranean Sea again.

15. Young SL. Impotence in bulls due to vascular shunts from the corpus cavernosum penis. JAVMA 1977;171(7):643.