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The Bovine Placenta In Health and Disease

W. L. Boyd, D.V.M.*

EXTENSIVE histologic changes of the endometrium are already well under way at the time the fertilized ovum enters the uterine cavity. During estrus the endometrium becomes hyperemic and edematous, while degeneration of a vacuolar type affects the surface epithelium. In the postestrous period the endometrium becomes markedly thickened, and the uterine glands increase in size and activity. In pregnancy there is further modification of the endometrium, particularly in the carunculae, which serve as a means of attachment for the fetal placenta. The carunculae, more familiarly known as cotyledons, constitute the maternal placenta. The above described changes which provide for the formation of the maternal placenta are initiated by the fertilized ovum and the estrogenic hormones, estrone and progesterone. These hormones, though differing clinically and functionally, are thought to be synergistic. This supposition seems quite logical inasmuch as the cells that form the graafian follicle later give formation to the corpus luteum. The first few days of the fertilized ovum within the uterine cavity may be regarded as difficult ones, largely from the standpoint of nutrition. The secretion from the uterine glands, known as uterine milk, is believed to provide nourishment for a brief period or until contact is made between the fetal and maternal placenta.

Following fertilization of the ovum there occurs a differentiation of cells into embryonic and extra-embryonic groups. The cells of the extra-embryonic group constitute the trophoblast and develop into the primitive chorion. The amnion now develops and surrounds the embryo, forming the amniotic cavity which contains the amniotic fluid. The allantois develops from the hind gut and forms a cavity (the allantois), which contains the allantoic fluid. This cavity is connected to the urinary bladder by a tube known as the urachus. The allantois carries with it the blood vessels that serve to vascularize the chorion. The outer layers of the fetal membranes are in intimate relation with the endometrium and constitute the fetal placenta. Wislocki (1) says at first the volume of allantoic fluid in sheep is 150-200 cc. followed by a decline to 25-100 cc. with subsequent wide scattering (100-1300 cc.) through most of pregnancy. In the cow the volume of allantoic fluid rises from 4,000 to 6,000 cc. and the amniotic fluid from an early peak of 5,000 cc. soon diminishes.

Cotyledons

The cotyledons, which in the nongravid uterus are discernable only as slight elevations, gradually increase in size as pregnancy advances. The cotyledons of the gravid cornu become tremendously enlarged, and while there is an increase in the size of those of the nongravid cornu, they never attain the caliber of those in the gravid cornu. The cotyledonary or cornual type of placenta develops only in the cow, ewe, and goat. The uterine cotyledon consists mainly of connective tissue, multiple capillaries, and is gland-free. The surface is covered by a layer of epithelium. There are no crypts present until after the contact is formed with the fetal placenta. The way in which the crypts
are formed is not entirely clear. Sven Wall (2) believes the crypts are formed structures, but expresses surprise that there is a chorionic villus for each crypt. Hammond (3) concludes that the maternal crypts are formed by the phagocytic action of the fetal or chorionic villi, which when fully developed, extend deeply into the cotyledons. Some writers are of the opinion that the crypts in the adventitious as well as the regular cotyledons are formed by growth and budding of the uterine epithelium before projections appear from the fetal membranes. The fetal cotyledons may be described as oval or circular island-like structures situated in or on the chorion and corresponding in number with the maternal cotyledons. Each fetal cotyledon consists of closely packed tufts or villi. These villi, which become quite long, consist mainly of capillaries and are covered by a layer of epithelial cells. Because of the presence of large numbers of capillaries, which insure a rich blood supply, the fetal cotyledons are red in color. The maternal cotyledons on the other hand are of a gray to reddish-gray color. This is due to the fact that they are not as vascular, and because they possess a greater amount of connective tissue.

Endocrinology

Though the exact time of contact between the fetal and maternal placenta is not definitely known, it probably occurs between the second and third month. Many abortions, the etiology of which is usually not detectable, occur at this period. It is possible that some of these may result from endocrine imbalance. The placenta, though a temporary structure, is highly important, serving not only as an organ of nutrition, but one of respiration also. The comparatively recent discovery of estrogens within the placenta has resulted in placing this organ among the endocrine group. The placenta may not only act as a storehouse for ovarian-formed estrogens but also engages in the formation of estrogens, as is evidenced by the fact that ovariectomy performed after the placenta is firmly attached does not interrupt the completion of pregnancy. This is further supported by the fact that the removal of the corpus luteum of pregnancy is not apt to result in abortion after the placenta is firmly connected. The placenta is further concerned with the housing or storing of certain vitamins.

Filtering Agent

The placenta as a filtering agent is very effective and forms a successful barrier against the admission to the fetus of harmful foreign material. An example of this is demonstrable in the Brucella infected cow and her calf at the time of birth. The calf will be negative to the agglutination blood test even though the dam may be strongly positive. This fact shows that the circulating antibodies of the dam have been unable to pass through the placenta into the blood stream of the fetus.

The phenomena terminating pregnancy or causing parturition are still inexplicable. The theory that parturition is influenced by endocrine activities is not at all illogical, but more convincing support gained by experimentation will be necessary before such theorizing can be properly evaluated. Normal parturition not only consists of giving birth to a live and vigorous calf but includes as well the prompt expulsion of the fetal membranes and abundant milk secretion. The fetal membranes perform a highly important function during the developing process of the fetus, but immediately following parturition their function ceases and they become a mass of dead tissue which, if not promptly expelled or removed, may result in temporary or permanent infertility and occasionally in loss of life.

Causes of Separation

The separation of the fetal and maternal cotyledons is the result of cessation of the fetal circulation which permits the falling away of the chorionic villi from the crypts of the cotyledons. The factors governing expulsion of the membranes are not fully known, but the act is no doubt influenced by their weight, the muscular contractions of the uterus, and finally the contractions of the abdominal...
muscles. The fetal placentae of the bovine do not separate from the uterus simultaneously but one after the other. The fetal membranes are as a rule expelled approximately six hours following parturition. In a certain percentage of cases they will be expelled in two or three hours, and not infrequently they will remain attached for a period of nine or ten hours, even though inflammation of the placenta is absent. When the fetal membranes are retained for more than ten or twelve hours, it is quite evident that placentitis is present, and they will have to be removed manually or allowed to remain within the uterus to undergo the process of putrefaction, being finally expelled as a putrid malodorous mass, consisting mainly of fluid, pieces of the membranes, and tissue debris.

**Time of Separation**

In experimental animals immediately following parturition we have upon numerous occasions experienced great difficulty in securing a sufficient number of placental attachments for bacteriologic and pathologic study, yet the entire fetal membranes of these animals were frequently expelled four or five hours later. Severe hemorrhages in normal separation of the fetal membranes are only rarely observed in the large animals. Necrosis, either physiologic or pathologic, is the most common alteration of the bovine placenta. Inflammation, often associated with edema and necrosis, is not confined to the cotyledons but involves the intercotyledonary chorion as well. Calcification of the placenta and placental blood vessels is not in such cases uncommon.

Inflammation of the placenta, if at all extensive, means retention of the fetal envelopes, which act invites sepsis and results in retarding or stopping involution. Involution acts as a barrier to infection, and it is a well established fact that the uterus supplied with normal muscle tone and which undergoes rapid reduction does not often absorb bacteria or their toxins.

The symptoms of retained placenta are as a rule not difficult of recognition, although certain cases, especially those in which none of the membranes protrude beyond the vagina, may escape early detection. Immediately following parturition, regardless as to whether the act of birth is normal or abnormal, portions of the fetal membranes will be seen protruding beyond the vulva. However, one must not in establishing a diagnosis attach too much significance to this observation. In a certain percentage of cows in which placentitis is well advanced uterine inertia will have developed to the point that parturition is retarded or delayed. The muscle tone of the uterus is lacking, the walls are flaccid, and there is no tendency toward involution. If the placenta at the cervical region has separated, the fetal membranes may frequently drop back into the uterus, especially if the placenta at the ovarian ends is adherent. Decomposition of retained fetal membranes brought about by the rapid invasion of the uterine cavity by streptococci, Bacillus pyogenes, and anaerobic bacilli, usually occurs within forty-eight to seventy-two hours. Putrefaction is evidenced by the presence of a reddish brown malodorous discharge containing shreds of the membranes, occasionally sloughed off cotyledons, and tissue debris. Strong vigorous cows may undergo this ordeal until the entire mass has been expelled, while numerous cows will suffer partial or complete anorexia, elevation of temperature, decreased lactation, mastitis, enteritis, and not infrequently metritis. Pelvic adhesions, abscess formation and pyometra are not uncommon sequelae. In retention of the fetal membranes it is at times difficult to draw a sharp line of demarcation between physiologic and pathologic processes. In other words, it is difficult to say where physiology ceases and pathology begins. The mortality is low, but occasionally death results from gangrenous metritis, septicemia, or terminal pneumonia.

In our investigations of the various changes occurring in the reproductive organs following parturition we have observed the following conditions: Healthy cows undergoing parturition will fre-
quently expel their fetal membranes within two or three hours, while others will require five or six hours' time before the membranes come away. When they are retained for more than a period of ten hours, one is as a rule safe in considering the condition as pathologic. In cows suffering with brucellosis, as previously stated, retention of the fetal membrane is a common symptom. When expulsion of the fetus occurs in the early stages of gestation, the fetal envelopes very often escape with the fetus. They may, however, be retained as early as ten or twelve weeks of pregnancy. They do not at this stage often protrude beyond the vulva, but they will be found extending through the cervical canal into the vagina. A very large percentage of abortions occur after the fifth month of pregnancy, when the placental attachments are more highly developed, and the process of inflammation is more advanced.

**Treatment**

A study of the literature shows that there is among veterinarians a wide difference of opinion as to what constitutes the proper method of treatment of this very common condition. This state of affairs is not confined to the veterinarians of this country but exists also among the veterinarians in foreign countries, especially where cattle breeding is an important and extensive industry. In 1918 Albrechtsen stated that the best treatment for retained placenta is still a question for discussion among the veterinarians of his country. He further stated that the most rational treatment, the one that leads to most prompt and complete recovery in the large majority of cases, is removal of the placenta, when this is carried out with due consideration for individual cases. The removal is to be done preferably during the first day, when the operation is performed on a fresh or slightly changed cow and at a time when the uterus has undergone slight contraction. He does not advocate this treatment for those in which the placenta is firmly adherent but advises that the operator wait until they can be taken away with slight traction, after which the uterus should be thoroughly irrigated with a large amount of warm physiological salt solution.

**Artificial Methods**

Artificial methods of treatment of retained afterbirth are varied and numerous. The use of eight ounces of peroxide of hydrogen in two quarts of water has been recommended as being helpful in retarding putrefaction and hastening separation. The employment of uterine capsules containing various ingredients has gained great popularity during the past few years. Many practitioners regard this form of treatment as highly satisfactory when used either alone or as an adjunct to manual removal. Others have discarded the use of capsules containing antiseptics and are resorting to uterine injections of mineral oil alone or combined with antiseptics such as boric acid or iodoform or both. After removal of the placenta either by hand or following its expulsion from the effect of putrefactive changes, many veterinarians are practicing uterine irrigation, using either saline solution or Lugol's or other mild antiseptics such as acriflavin, therapogen, sterilac, and numerous other agents. The use of animal charcoal contained in gelatin capsules has received prominent mention. This form of treatment originated from the investigational work conducted by Oppermann of the Veterinary School of Hanover, Germany. In connection with this form of treatment, it is important that there should be no douching of the uterus either before or after the introduction of the capsules. If irrigation is performed, the action of the charcoal will be diminished and the result less effectual.

**Pituitrin**

Extracts from the postpituitary body, pituitrin or pitocin, have been recommended as being of considerable value in the treatment of retained afterbirth. It is a known fact that pitocin stimulates contraction of all unstriped muscle, regardless of its innervation. The use of this biologic agent must be instituted shortly after parturition. This requirement makes it difficult to determine its real value, for as previously explained the average time
required for normal individuals to expel the membrane varies from six to eight hours. The fact that it must be administered immediately or shortly after parturition minimizes its value to the practicing veterinarian. More recently the synthetic estrogen, stilbestrol, has been widely recommended. But like other forms of therapy it can only be regarded as a supplementary form of treatment. We believe that manual removal constitutes the most satisfactory method of treatment when it is performed with due consideration for individual cases. We know that it is not safe to follow any set of fixed rules. In numerous cases the fetal membranes may be very easily removed within twenty-four hours, while in other animals successful manual removal within forty-eight to seventy-two hours is impossible. In a certain percentage of cases manual removal is beyond question until complete separation has resulted from the process of putrefaction, at which time they may be removed by irrigation together with the application of rectal massage. Manual removal of the fetal membranes should not be attempted unless the placenta can be detached without resulting in irritation, pain, or hemorrhage. In those cases where necrosis is extensive with sloughing of the cotyledons and thickening of the chorion the membranes and tissue debris should be manually removed. The manual removal of all the fetal membranes from cows which have aborted or from cows which have given birth to strong, healthy calves at the termination of the normal gestation period is usually impossible, and when the operator spends one hour or more in the effort to remove these tissues, more harm than good is accomplished. Because of this sort of practice many of the cattle breeders of this country have decided adverse opinions relative to the value of manual removal as a satisfactory treatment for retention of the placenta.

Irrigation

Many cases when first observed present such a filthy appearance and condition that manual removal is anything but inviting. But once the exterior of the genitalia is thoroughly cleansed and the patient is placed in a clean, dry stall, conditions become far more encouraging. The operator is advised to use rubber gloves to guard against infection. Successful irrigation of the uterine cavity with the fetal membranes attached is impossible, the fetal sac will receive the irrigating fluids, which in many instances becomes difficult of removal on account of portions of the membranes being drawn into the fenestra of the catheter in the siphoning process. Some benefit may be derived by irrigation if one is careful in the selection of one's cases. Large quantities of exudate may in this way be removed and putrefaction is held in abeyance. If, on the other hand, the walls of the uterus are more or less flaccid and void of muscle tone, irrigation is exceedingly dangerous and should not be attempted. The fluids injected in these cases cannot be siphoned off successfully, and they not only add weight to the already weakened organ but furnish more material for bacterial development. We use in many of our cases mineral oil, lard, or vaseline in the attempt to allay irritation and to discourage putrefactive changes. The cow with retained fetal membranes should be isolated and should receive careful consideration until she is ready to be returned to the herd. In those cases where manual removal of the fetal membranes is deemed inadvisable, we recommend clipping off the membranes close up to the vulva in order to prevent, if possible, infection of the udder and intestinal disorders of the new born. One should be careful to leave enough of the membranes protruding in order that the cervical canal will remain open.

In the treatment of retained placenta we should at all times remember that we are confronted with the condition of metritis, the course of which we endeavor to modify or check. The removal of the fetal membranes, while of great value, does not terminate the inflammatory process. The after treatment is very essential if we expect to minimize decreased breeding efficiency, which frequently results. Uterine douching with mild antiseptics or saline
solutions together with the gentle application of rectal massage is of wonderful value in hastening the retarded involution and in preventing the development of certain chronic inflammatory conditions, which if not recognized early and proper treatment instituted, will often result in incurable sterility. Stilbestrol occupies a prominent position relative to therapy employed in stimulating the processes involved in overcoming or correcting delayed involution of the uterus.

Conclusion

In conclusion I wish to mention the use of general stimulants and tonics in those cases in which there is inappetance and weakness, and the employment of liberal doses of intestinal antiseptics in cases where diarrhea develops as a result of absorption of toxins liberated in the uterine cavity. Educational work with the breeder should be continued until he thoroughly appreciates the serious nature of retained fetal membranes. He should be warned that this common pathologic condition not only results in decreased milk production, but that the future breeding efficiency of his animals is greatly reduced. Lowered milk and beef production and sterility result in severe economic losses and in this respect tends to make cattle breeding and dairying a hazardous business enterprise.

Results Obtained in a Study of Pregnancy Termination Over a Period of Two Years

An experimental herd consisting of both Bang's disease and Bang's disease free animals

<table>
<thead>
<tr>
<th></th>
<th>Number of pregnancies in positive animals</th>
<th>Number of abortions</th>
<th>Number of retained placentas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bang's disease</td>
<td>52</td>
<td>9 or 17.36%</td>
<td>20 or 38.46%</td>
</tr>
<tr>
<td>Bang's disease free</td>
<td>56</td>
<td>1 or 1.78%</td>
<td>8 or 14.29%</td>
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</tbody>
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A Beef Cattle Herd Consisting of Bang's Disease

<table>
<thead>
<tr>
<th></th>
<th>Number of pregnancies in negative animals</th>
<th>Number of abortions</th>
<th>Number of retained placentas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bang's disease</td>
<td>71</td>
<td>11 or 15.49%</td>
<td>20 or 28.25%</td>
</tr>
<tr>
<td>Bang's disease free</td>
<td>66</td>
<td>5 or 7.69%</td>
<td>17 or 25.76%</td>
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Nineteen-forty-six promises to be the biggest in the history of America's dog food industry. The days we are passing through now are in many ways an intensified repetition of the period of expansion which began right after World War I. People who have had canine pets during the war years are not letting them go, and others are adding them to their households as fast as they can be obtained. Increasingly the dog is being discovered as a delightful third person in childless homes or where elderly couples reside, and a romping companion where there are youngsters. Service folk in particular appear to want dogs as they return to their old homes or set up their own new homes. The trend to suburban and rural homes for city people, with the opportunity this holds for the keeping of dogs, also augurs well for the future of the canine.

Relatively high employment and good wages always coincide with big increases of pets in the home. The demand, however, is not alone for dogs, but for well-bred dogs. Registrations of pure-bred dogs are increasing month by month. More dog shows are on next year’s calendar than ever before, and public attendance at these dog shows is likely to be phenomenal. All of this is evidence of a great new interest in dogs, and all of it, of course, very heartening to the dog food industry.

Another encouraging development is the large number of service men and women who have indicated a determination to get into dog work as a permanent vocation.

Canned dog foods are expected to re-enter the picture some time during 1946 but as yet it is uncertain just what changes, if any, this will make in the marketing of the popular meal-type and baked products.

REFERENCES