which will be interpreted as signs of danger. All animals should be examined regardless of being in heat. An alert client with good breeding records can reduce the preservice anestrous to a minimum and only a minimal amount of animals will have to be treated by you so it is in the client's hands—if he uses your advice and the reproductive records wisely, he can do the job. Let us look at the second category. Here we have an entirely different situation. Remember that I said a client alone, if he is following your advice, can reduce the incidence of preservice anestrous to a minimum. How about the postservice anestrous? The client is helpless because once an animal is bred, failure to return in heat is taken as an indication and evidence for pregnancy and, in fact, that is what the A.I. organization reports. Should I point out again how this assumption is erroneous? This is, I think, the form of infertility where you as veterinarians probably can do the most good. It should be the backbone of the herd health programs and here we should detect those animals which shall be serviced and which have not conceived at the earliest possible time. Here we are talking about early pregnancy diagnosis. That is the only procedure which can help your clients to minimize the loss due to this costly type anestrous—*early* pregnancy diagnosis. I know there are some people here who believe we should not approach the animals before 45 or 60 days because of the risk of damaging the amniotic vesicle. I do not agree with that opinion. Thank you very much.

Diagnosis of Abortion in Cattle

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A recent evaluation of diagnostic laboratory data concerning bovine abortion in five northeastern states was reported by Hubbert, et al., for an 11-year period, 1960-1970 (2). In a series of 3812 bovine aborted fetuses, an infectious cause of abortion was diagnosed in 889 (23.3%) of the cases. The majority of diagnostic laboratories throughout the world do not establish diagnosis on more than 25% of aborted specimens. A higher percentage of diagnoses can be established by concentrated efforts in obtaining more adequate aborted specimens and by conducting more detailed microbiological and pathological examinations. Ideally, the entire fetus should be submitted to a diagnostic laboratory as rapidly as possible so as to minimize decomposition and contamination. The placenta should be submitted because in many of the infectious cases of abortions inflammatory placental lesions will be evident and the organism may be isolated. In some cases, the infectious agent can be isolated from the placenta and not from the fetus. In cases of retention of the placenta, a portion may be removed manually. Paired blood samples taken two to three weeks apart may be of value but are of less value than fresh aborted specimens. The practicing veterinarian should be supplied with forms for recording the history of the herd and the breeding record of the individual cow in question (Appendix). Since considerable effort and expense is devoted to the laboratory examination of specimens, we believe that the owner and the local veterinarian should cooperate to the extent of presenting adequate specimens and records. We have established that it costs at least $125 to conduct a detailed examination of an aborted fetus and placenta for various microbiological agents and pathologic lesions. Most laboratories have not been able to devote this amount of funding to all aborted specimens over a prolonged period of time. Therefore, it is necessary to be selective in concentrating diagnostic efforts in herds which have severe abortion problems.

A three-step approach should be used in diagnosing abortion problems. First, identification of the problem herd. When should intense investigation of a problem be initiated? It has been determined in New York State that dairy herds which are bred artificially average about a 2.5% abortion rate. Naturally bred herds have a 5% abortion rate on the average. Therefore, the cause or causes of abortion should be investigated when the incidence goes above 5%. If there is an infertility problem, i.e., repeat breeding, the first aborted fetus should be examined.

Second, collection and submission of breeding data and aborted specimens to a diagnostic laboratory.

Information on aborting cow: Identification of animal, number of previous calves, previous breeding trouble, services for current pregnancy, date of each service and name of sire, AI or natural (if AI, source of semen), signs noted during pregnancy. Herd information: number of cows, bulls, self-contained, adults purchased within year, disease status of herd, (Brucellosis, Leptospirosis, Vibriosis, Trichomoniasis), vaccinations, breeding problems during past year, duration of the outbreak, repeat breeding, regularity of estrous cycles, number of abortions, number of retained placentas, number and type of malformed calves, mummified fetuses, feeding, management problems, estrus detection, type of housing.

Specimens to be submitted by the most rapid route so as to minimize post-mortem autolysis and contamination: placenta, fetus (entire fetus), blood sample, uterine discharge.

Third, the third step is up to the diagnostic laboratory—identification of the cause.

1. Infectious agents:

A. Bacteria

Brucella abortus - Although brucellosis is rarely diagnosed as a cause of abortion in cattle in the Northeast at present, the decreasing use of vaccination is resulting in the development of highly susceptible populations. Brucella problems will be encountered in these herds when exposed. Therefore, a constant awareness of potential brucella problems must be maintained.

Brucellosis produces quite characteristic lesions in the bovine fetus. The most outstanding fetal lesion is bronchopneumonia which is present in varying degrees in most fetuses aborted in the last half of pregnancy. In some cases, the pneumonia is so severe that it may be diagnosed grossly. The majority of fetal pneumonias due to bacteria do not have grossly visible lesions. Necrotising arteritis, especially of the pulmonary vessels, is seen quite frequently. The liver, spleen and kidney may contain foci of necrosis and granulomas with giant cell formations. If a severe pneumonia is present in an aborted fetus, brucellosis should be suspected.

Vibrio fetus - One cannot over-emphasize the necessity for the isolation and identification of *Vibrio fetus venerealis* before making a diagnosis of venereal vibriosis in cattle. The widespread use of the fluorescent antibody test on vaginal mucus has resulted in false diagnosis of vibriosis in numerous herds. Many of these problems have been brought to our attention in recent years by concerned veterinarians. They have wanted to know how the herd became infected and whether they should vaccinate the herd against vibriosis. Most of the cases have involved dairy herds which had been breeding artificially for many years with semen from reputable artificial breeding associations. We know that many of the large AI studs are free of venereal vibriosis and that if *V. fetus* carrier bulls are used, the use of antibiotic-treated semen controls the spread of the disease. Therefore, the implication that these studs are responsible for disseminating venereal vibriosis is unjustified.

The following facts should be considered before rendering a diagnosis of venereal vibriosis in cattle.

1. Bovine vibriosis, due to *V. fetus venerealis* has been reduced to a very low level in the northeastern United States.

The last cases which were definitively diagnosed by culture and identification of the organisms at the New York State Veterinary College occurred in 1966 in dairy cattle and in 1969 in beef cattle. The disease was eliminated from the local artificial breeder's stud in 1967 (3) and has not returned to date. Prior to this time, the disease was controlled by the use of antibiotic-treated semen.

2. A definitive diagnosis of venereal vibriosis in cattle can not be made by use of the fluorescent antibody test by the vaginal mucus agglutination test.

V. fetus venerealis and *V. fetus intestinalis* cannot be differentiated by use of the fluorescent antibody test. Many cattle harbor *V. fetus intestinalis* and shed the organisms in their feces. If the vagina becomes contaminated with feces, vibrio organisms may be detected by the F.A. test and the prescence of *V. fetus intestinalis* in the vagina can induce the formation of vaginal mucus antibodies which are detectable by the mucus agglutination test.

3. *V. fetus intestinalis* has been isolated on rare occasions from aborted fetuses. It has not been established that this organism causes failure of conception.

In summary, the F.A. and vaginal mucus agglutination tests may be used as screening tests but a positive diagnosis of venereal vibriosis in cattle cannot be made without isolation and identification of *V. fetus venerealis.*

Leptospira - The fetus usually dies 24 or more hours before it is expelled. Consequently, the fetal tissues are decomposed so that it is very difficult to demonstrate organisms in tissue

sections. Leptospira can be demonstrated more readily in placental tissue by the use of fluorescent antibody or by silver stains.

When serologic tests are used to diagnose leptospirosis, a variety of antigens must be used. Our diagnostic laboratory uses the following serotypes: *pomona, grippotyphosa, canicola, sejroe, autumnalis, ictero-hemmorrhagiae, ballum, hardjo, bataviae and pyrogenes.*

Listeria monocytogenes - The fetus is usually decomposed by the time it is expelled in cases of abortion due to *Listeria monocytogenes.* The organism can be cultured from affected cotyledons, abomasal content and various fetal tissues. Focal areas of necrosis are evident in the liver. Numerous, small, gram-positive rods will be present in the foci of necrosis.

Cornebacterium pyogenes - Cr. pyogenes frequently produces a very severe suppurative placentitis which may be confused with brucella placentitis. The fetus has pneumonia and hepatitis. The organism can be isolated in pure culture from the placenta and fetal tissues.

Salmonella - Abortion may occur as a secondary manifestation of infection due to *Salmonella typhimurium* or *Salmonella dublin.* Gastroenteritis is the primary manifestation of the disease.

A variety of other bacteria including streptococci, staphylococci and *E. coli* are occasionally incriminated as causes of bovine abortion.

Mycoplasma - Mycoplasma bovigenitalium has been isolated from a few aborted fetuses. The importance of mycoplasma in relation to infertility and abortion remains to be established.

B. Viruses

Infectious bovine rhinotracheitis-infectious pustular vulvo-vaginitis (IBR-IPV) abortion in cattle may occur either in natural outbreaks of the disease or following vaccination with live virus. In cases of fetal infection, the fetus generally remains in utero for 24 hours or more after dying so that the tissues are decomposed. Although focal areas of necrosis are usually present in the liver and in many other organs, it is extremely difficult to demonstrate inclusion bodies in the liver and kidney. Inclusion bodies have been demonstrated in the fetal adrenal when they could not be found in the liver and kidney. The bovine herpes virus as well as some of the other herpes viruses appear to have an affinity for adrenal tissue. The fetal adrenal does not appear to decompose as rapidly as liver and kidney. Consequently, the inclusions may be demonstrated in adrenal cortical tissue after they have been destroyed in other tissues as a result of autolysis.

Bovine virus diarrhea - Abortion may occur when cows become infected during the first trimester of pregnancy. Cows which become infected at approximately 150 days of gestation give birth to full term calves with cerebellar hypoplasia and ocular abnormalities including retinal atrophy, optic neuritis, cataract and microphthalmia (1). Cows infected later in pregnancy give birth to normal calves which have antibodies against the virus.

Epizootic bovine abortion (Chlamydia, Psittacoid agent) - The mucus membranes of the eye and mouth are pale and frequently contain petecchial hemorrhages. The liver is often nodular due to the development of chronic passive congestion and the lymph nodes are considerably enlarged. The combination of a nodular liver with enlarged lymph nodes is very suggestive of psittacoid infection of the fetus. In contrast to IBR abortion, the fetuses which are expelled as a result of psittacoid infection are usually fresh or even alive and in the later stages of pregnancy subcutaneous hemorrhages and ascites occur frequently. Chronic passive congestion of the fetal liver may be due to myocarditis due to other infectious agents. The circulatory lesions of the liver are secondary to myocarditis. There is a correlation between the degree of myocarditis and myocardial degeneration and the severity of chronic passive congestion of the liver. The lymph nodes have a marked proliferation of reticuloendothelial cells and occasionally areas of hemorrhage and necrosis. In some cases, giant cells may be present in the lymph nodes. Proliferation of R-E cells is evident in many organs. The brain is one of the most useful tissues to examine when psittacoid abortion is suspected because there is a rather characteristic proliferation of R-E cells especially in the meninges.

Epizootic bovine abortion has been occurring as a severe problem in California for many years. Aborted fetuses with the characteristic lesions have been seen sporadically for many years in New York State but Chlamydia have not been isolated from any of the aborted specimens. It appears that as the fetal lesions become increasingly severe, the difficulty of isolating the agent increases.

Parainfluenza - Parainfluenza 3 has been incriminated in a few cases of abortion.

Bluetongue - Varying degrees of degeneration of the cerebral hemispheres may be found in aborted and term calves from cows infected during pregnancy. Before it was widely recognized that Bluetongue was responsible for producing these lesions, we investigated a herd in Vermont and one

in New York State which has histories of abortions and the birth of calves with incoordination. Cavitation of the white matter of the cerebral hemispheres was evident in many of the cases. It is possible that Bluetongue may have been responsible for the problem.

C. Protozoa

Trichomonas fetus - Toxoplasmosis - Although this is a serious cause of abortion in sheep and swine in some areas of the world, it has not been definitely incriminated as a cause of abortion in cattle.

D. Fungi

Mycotic placentitis is one of the most frequently diagnosed causes of abortion in areas in which brucellosis has been eradicated. Abortion is usually sporadic. One or two abortions may occur in a herd of 40-50 cows. It is rare to have a herd outbreak of mycotic abortion. The disease usually occurs in advanced pregnancy but may occur at any stage of gestation. In the more advanced cases, there will be leathery thickening of the placenta including both the cotyledons and the intercotyledonary tissues. The edges of the cotyledons are thickened and grayish-tan in color. The thickening is due to a combination of inflammatory lesions and necrosis resulting in sloughing of maternal tissue with the fetal tissue. The edge of the cotyledon is the area which should be smeared in search for fungal hyphae and for sectioning. Organisms are more likely to be found in large numbers in areas of the necrotic maternal tissue. With hematoxylin and eosin stained sections, the walls of the hyphae will stain blue. If the hyphae are rather regular in structure and are septate, they are most likely *Aspergillus fumigatus.* If they are non-septate and irregular in contour, they are usually of the mucoracious species. *Aspergillus fumigatus* is isolated from approximately 65 percent of the cases of mycotic placentitis. The fungi can be demonstrated most vividly with Gomori's methenamine silver stain. The silver precipitates on the wall of the hyphae. The background material stains green. The hyphae can usually be observed even under low magnification. Fungi appear to have a predilection for blood vessels so there is usually arteritis and frequently thrombosis of placental vessels. Fetal skin lesions are present in approximately 20 percent of the cases of mycotic placentitis in cattle. They appear as irregular to circular gray lesions which are most numerous on the head and neck. In advanced cases, they may be found on all parts of the body surface. Many of the aborted fetuses which are expelled because of mycotic placentitis are underdeveloped because the placental lesions interfere with nutrition of the fetus.

The frequency with which mycotic placentitis is diagnosed is directly related to the frequency of examination of placental tissues. In Great Britain and in New York State, mycotic placentitis was diagnosed as the cause of abortion in 20% of the cases when placental tissue was submitted for examination. When placental tissue is not submitted with the fetus, the diagnoses of mycotic abortion are often below 10%.

It is a sporadic disease which seldom affects more than one or two animals in a herd.

The non-gravid bovine uterus is very resistant to fungal infection. We believe that the primary lesion in the cow is in the forestomach, especially the omasum. Cows which are subjected to stress during pregnancy may develop ulcers of the omasum and the majority of active omasal ulcers are invaded by fungi. This provides a portal of entry to the blood stream and the placentome provides a suitable environment for the growth of the fungus.

2. Toxic agents:

Nitrate - Abortion occurs only when there is other clinical evidence of nitrate poisoning.

Plants - From the reports in the literature, it appears the sheep experience more reproductive problems as the result of ingesting a variety of toxic plants during pregnancy than do cattle.

3. Endocrine factors:

Estrogen excess: administered estrogens, plant estrogens; progesterone deficiency (this is difficult to prove); prostoglandins; corticosteroid excess.

In 1967 we attempted to induce the formation of omasal ulcers in pregnant cattle with the anticipation of producing mycotic placentitis (4). We had previously induced the formation of omasal ulcers, which were invaded by fungi by administering corticoids to heifers.

Five Holstein cows (six to seven years of age), in their last trimester of pregnancy, were administered corticosteroids. Two animals received intramuscular injections of flumethasone* (5 mg.) daily for four days. One had a dystocia five days after the beginning treatment resulting in death of the calf. The cervix had failed to dilate normally. Treatment was initiated on the 222nd day of gestation. Fetal maceration was detected five days subsequent to the start of the administration of corticosteroids to the second animal in which treatment was started on the 237th day of gestation.

**Flucourt, Syntex Lab., Animal Health Division, Palo Alto, California.*

The third animal received intramuscular injections of flumethasone (2.5 mg) daily for five days starting on the 224th day of pregnancy, and 2.0, 1.5, 1.0 and .5 mg. on days six through nine respectively. On the tenth day 400 units of A.C.T.H.** was administered intramuscularly. A decomposed fetus was expelled five days later.

The fourth animal received intramuscular injections of flumethasone (5 mg) daily for five days starting on the 221st day of gestation and 3.5 and 2.0 mg on days six and seven respectively. On day eight a 30-lb. live calf was born.

Starting on 244th day of gestation, the fifth animal received 10 mg. of dexamethasone*** orally once a day for five days, followed by 5 mg on days six and seven and 2.5 mg on days eight and nine. Four hundred units of A.C.T.H. were given intramuscularly on the tenth day. On the eighth day of treatment the cervix dilated slightly and remained so for five days. A caesarean section was performed and a live bull calf delivered.

4. Malformation:

Genetic and drug or viral induced chromosal abberations.

5. Accidents:

Removal of CL during pregnancy; early pregnancy diagnosis (30-45 days), rupture of amnion, rupture of fetal heart without rupture of amnion; insemination or intrauterine treatment during pregnancy.

***Adrenomone, Armour-Baldwin Lab., Box 1022, Chicago, Ill.*
****Azium bolus, Schering Corporation, Bloomfield, New Jersey.*

6. Nutritional factors:

Vitamin A deficiency, starvation, iodine deficiency, selenium deficiency?

7. Miscellaneous:

Non-productive specimens. In our experience the submission of these specimens seldom results in the establishment of a diagnosis: Twins, term fetuses, young fetuses (less than 3 months), mummified fetuses, macerated fetuses.

Conclusion

Aborted fetuses and placentas should be submitted for examination as rapidly as possible. The best procedure is to have someone take the specimens directly to a diagnostic laboratory. Iced specimens frequently become contaminated en route. Freezing destroys some pathogenic organisms.

To solve current abortion problems, there is need for more cooperation among herdsman, veterinary practitioners and diagnostic laboratory personnel.

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NEW YORK STATE VETERINARY COLLEGE
lthaca, New York

Data to be Submitted with Aborted Fetus

Owner: _____ Veterinarian: _____
Address: _____ Address: _____
Name of cow: _____ Breed: _____
Ear-tag No.: _____ Age: _____
Number of previous calves: _____
Previous breeding trouble: _____

Service for current pregnancy. List date of each service and name of sire for each service. State whether natural (N) or artificial (AI) service.

_____
_____
_____

If AI, source of semen: _____
Infertility treatment prior to pregnancy: _____
_____
Date of abortion: _____ Date submitted: _____
Comments regarding condition of cow and uterus (septic metritis, mastitis, etc.): _____
_____
Symptoms noted during pregnancy (diarrhea, coughing, mastitis, premonitory signs of abortion, etc.): _____
_____
Treatments during pregnancy: _____
Condition of calf: _____ Sex: _____

Submit placenta or portion of placenta (if retained) including at least one fetal cotyledon and blood sample from dam with aborted fetus.

HERD INFORMATION

No. of breeding animals – Cows: _____ Bulls: _____
Self contained: _____ Adult cattle purchased within year: _____

Disease status of herd:

Brucellosis: _____ Vibriosis: _____
Leptospirosis: _____ Trichomoniasis: _____
Other diseases: _____

Vaccinations:

Brucella Strain 19: _____ Leptospirosis: _____
Other vaccinations: _____

Information on breeding problems in herd during past year:

No. of abortions: _____
No. of retained placentas: _____
Repeat breeding: _____
No. and type of malformed calves: _____
Other breeding problems: _____

Hay, bedding, and silage used during pregnancy:

	Kind	Amount of dust or mold: Slight	Moderate	Severe	When used?
Hay					
Bedding					
Silage					

Other types of feed – grain, etc.: _____

Diagnosis and Treatment of Cows with Cystic Ovaries

S. J. Roberts, *D.V.M., M.S.*
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Next to anestrus or failure of heat detection and repeat breeding, cystic ovaries are the most common cause of infertility in dairy cattle in the United States. Roberts has cited reports to indicate that over 10 percent of problem breeding cows have cystic ovaries and that the incidence of cystic ovaries appears to be rising rapidly since about 1950, possibly associated with increased milk production and artificial insemination.

I. Diagnosis:

Behavioral signs:

Incidence of:	Postpartum days 0-60	60-150
Anestrus	60 - 85%	15 - 40%
Nymphomania (Frequent, continuous or irregular estrous signs)	15 - 40%	60 - 85%

Anestrus may change to nymphomania and the latter to anestrus in the same cow. Most nymphomaniac cows frequently attempt to ride other cows but refuse to stand for mounting by other cows. All signs will vary in intensity and degree between cows and in the same cow. Anestrus may be mistaken for pregnancy.

Clinical signs — external:

Edematous vulva (60 - 90%). Sunken or relaxed sacrosciatic ligaments (70 - 90%). Thick, tenacious, grey to white mucus in vagina or at vulva. (Rarely - elevated tail head [sterility hump], dislocated hip(s), prolapse of vagina, or pelvic fracture).

Internal or rectal examination:

Flaccid, relaxed, atonic, atrophic uterus. In a few advanced, long-standing cases, may have muco- or hydrometra with thin uterine walls. Loose, flaccid, elongated broad ligaments. Cysts, either *follicular* (90%) (thin-walled, easy to rupture) or *luteal or luteinized* (10%) (thicker-walled and hard to rupture manually) present on both ovaries (50%), right ovary (30%) or left ovary (20%). Cysts