# Course of Gynaecology

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   *Faculty of Veterinary Medicine, Alexandria University*

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   *Professor of Theriogenology, Faculty of Veterinary Medicine, Cairo University*

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   *Professor of Theriogenology, Faculty of Veterinary Medicine, Alexandria University*

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   By Prof. Dr. M. I. El Sherry
   *Professor of pathology, Faculty of Veterinary Medicine, Assiut University*

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   AHMED ALI
   MS, PhD
   *Dept. Theriohenology, Assiut Univ., Assiut, Egypt*

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Treatment or Repeat Breeder
Post-partum Uterine Infection in Cattle
Diagnosis and Treatment

By
Professor Dr. Fekry Hussein
Faculty of Veterinary Medicine Alexandria University

Infertility can be a serious problem, especially in high producing lactating dairy cows.

During the post partum period, cows must have a rapid and uneventful involution of the uterus and resumption of normal ovarian activity, followed by an accurately detected estrus with a high conception rate at breeding.

All of this must occur, whilst the cows produces large amounts of milk and, being in early post-partum, is in a negative energy balance.

Physiological aspects of the post partum period

Uterine involution:

It is generally takes 3 weeks for the uterus to return to its normal non-pregnant size. The time required for complete physiological involution (including regeneration of the epithelium of the endometrium) varies from 40 to 50 days. Endogenous levels of prostaglandin F2 α metabolites are elevated during the first 7 to 23 days after calving.

During the first 7 to 10 days after calving there is usually a noticeable loss of fluid and tissue debris (= Lochia).

The presence of this yellowish or reddish brown discharge that can contain tissue particles (expelled cruncles) is normal.

The volume can vary from 500 ml in primipara to 1000 – 2000 ml in pluripara.
Ovarian activity

During the first 8 –14 days postpartum, the pituitary gland is not responsive to GnRH.

LH pulses occur infrequently and the ovaries produce minimal amounts of estrogens and progesterone.

The interval between calving and first ovulation varies greatly in the post partum cow depending on the breed, nutrition, milk yield, season and the presence of a suckling calf.

The majority of dairy cows should have resumed cyclic activity by day 40 post-partum. Under farm conditions, however, many are not observed in estrus. In suckled beef cows, the first ovulation occurs later and with considerable variation within and between herds.
Conception

Following the completion of uterine involution and the resumption of normal cyclic activity, the cow can be bred. Attempts to breed animals too early after calving will result in poor conception rates. Therefore, it is generally recommended that cows are not served before day 40 – 50 post partum. Actual fertilization occurs in about 85% of the cows but, as a result of embryonic and fetal mortality, the final calving rate drops to around 50 – 60%.

Early embryonic mortality during the first 15 days post-insemination is a major component of this loss. Embryonic or fetal, death after day 16 of gestation will invariably result in a delayed return to estrus, since, after the embryonic death, it will take some time for the corpus luteum of pregnancy to disappear.

Negative energy balance

a. Decrease in LH release.

a. Decrease reactivity of ovary to LH stimulus

a. Decrease in progesterone production

a. Delay in resumption of cyclic ovarian activity.

b. Impaired follicular growth and development (COD)

c. Insufficient CL function (EMM).
Retained placenta

- Normally the placenta is expelled within 6-8 hours post partum.
- When the placenta has not been shed by 24 hours after calving.
- The incidence rate of retained placenta varies from 4.0 – 16.1%, but can be much higher in problem herds.
- Although it has been established that several genetic, nutritional, immunological and pathological factors influence the separation of the bovine placenta, the etiology of retained placenta is not fully understood.

Prevention:
Hygiene at calving.
Adequate nutrition (Ca, Se, Vit. E, etc.)
Control of infectious diseases.
Adequate dry period (6-8weeks).
Administered prostaglandin F2α immediately after parturition to cows that had been induced to calve with corticosteroids will lead to reduce significantly retained placenta as compared to untreated controls.
Treatment of Retained Placenta

- Myometrial Stimulants.
- Antibiotics.

Abnormal (vaginal) discharge:

- Abnormal vaginal discharge is generally a symptom of Endometritis. It may, however, also be caused by inflammation of the vagina or the urinary tract.
- The symptoms can be restricted to the reproductive tract but the cow may also show severe signs of systemic disease.
- It is hard to evaluate and compare different studies on Endometritis because there is considerable confusion on the definitions and means of diagnosis.
- Most authors are now of the opinion that abnormal parturition and puerperal complications play an important role in bovine infertility.
- Abortion, retention of fetal membranes, premature births, twin births, dystocia, post-partum metritis, pyometra and lacerations or lesions of the uterus, cervix, vagina and vulva can all be followed by a Post-partum uterine infection (Persistent Endometritis). The retained fetal membranes are considered to be one of the most common Post-partum disorders.
- Duration of retention, parity and presence or absence of other diseases such as metritis and ovarian cysts complicates the effects of retention of fetal membranes on fertility.
- Dystocia
- Retained placenta
- Uterine infection
- Metabolic disorders
- Ovarian cysts
- Mastitis
**Types of Uterine Infection**

1. Endometritis.
2. Metritis.
3. Pyometra.

OR

1. Acute catarrhal.
2. Chronic catarrhal.
4. Pyometra.

**Metritis**

**Characterized by:**

- Inflammation of all layers of the uterine wall.
- It usually develops within a few days to 2 weeks after calving.
- May be accompanied by severe septicemia or toxemia (septic metritis).
- It is usually sequel to uterine inertia and delayed involution caused by prolonged dystocia, traumatic obstetric operations, uterine torsion or uterine eversion.

**Factors influence the severity and prevalence.**

- Species
- Pathogenicity of the causative organism
- The cellular and immunological defenses.
- Dietary management of the affected animal.
- Environmental sanitation.
- Retained fetal membrane will be common (high correlation between placental retention and metritis).
- Infectious diseases (brucellosis, campylobacteriosis ...).
## Terms, Definitions and Means of Diagnosis in the Case of Endometritis

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Means of diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute endometritis</td>
<td>Enodometritis occurring less than 14 days post-partum with: - a large amount of foul smelling, reddish brown, watery uterus exudates and a thin uterine wall, or - a limited amount of malodorous, purulent uterus exudates and a thick uterine wall. - The term toxic is used when the acute endometritis is accompanied by systemic illness.</td>
<td>Exudates (aspect and quantity) Interval post-partum Assessment of systemic illness Rectal examination of the uterus</td>
</tr>
</tbody>
</table>
### Terms, Definitions and Means of Diagnosis in the Case of Endometritis

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Means of diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-acute / Chronic Endometritis</td>
<td>Endometritis occurring more than 14 days post-partum with (muco) purulent discharge at vaginoscopic examination</td>
<td>Vaginoscopy Rectal examination</td>
</tr>
<tr>
<td>Pyometra</td>
<td>Endometritis with a large amount of (mucopurulent fluid in the uterus and a persistent corpus luteum, occurring from 3-4 weeks after parturition</td>
<td>Rectal examination of the uterus and the ovaries</td>
</tr>
</tbody>
</table>
Uterine Tubal Diseases

- Hydrosalpinx
- Salpingitis
- Pyosalpinx
- Diagnosis of Tubal obstructions.
- Control and treatment of uterine tube diseases.
- Treatment of diseases of the uterine tube is usually not possible.
- Sexual rest may be of some benefit in valuable animals to permit resolution of the lesions.
- Systemic antibiotics may be indicated in some cases.
- Control these conditions:
  - Avoid traumatic manipulation of the ovaries (enucleation of corpora lutea, intentional rupture of ovarian cysts).
  - Avoid infusion of large volumes of fluid or irritating chemicals into the uterus.
  - Avoid the administration of large doses of exogenous estrogens (contractions & forced infected exudates).

General Symptoms of Metritis

- Loss of appetite
- Milk yield below expectations
- Moderate depression
- Temp. Is normal or slightly rise.
- May called Lochio-metritis or Lochiometra

Control & Prevention of Uterine Infections

- Cows that suffer from abnormalities around the time of calving such as hypocalcaemia, dystocia and retained placenta are more likely to suffer from uterine diseases than are cows that calve normally.
- Routine treatment of cows with antibacterial drugs & chemicals may be beneficial & in some cases has reduced fertility.
- Strict sanitation in the calving environment.

- Proper management during the dry period.
Treatment of uterine infection

1- Anibacterial drugs

Drug recommendations:-

- It must be active against the primary uterine pathogens.
- It must reach concentrations at the site of infections above the minimum inhibitory concentration (MIC) for the infecting organism.
- It must be active in:
  1. The presence of organic debris
  2. In the anaerobic environment of the postpartum bovine uterus
  3. Withdrawal time should be put in consideration

Many antibiotics and antiseptic chemicals interfere with the normal uterine defense mechanism by reducing phagocytosis.

II- Hormonal Treatment

- Prostaglandins
- Exogenous estrogen
- GnRH

III- Drugs Causing Uterine Irritation

- Lugol’s solution 0.5%

IV- Animal Own Plasma / Serum

- It has been demonstrated that the addition of small amount of serum or plasma to uterine secretion can increase the opsonizing capacity and significantly enhance the phagocytic ability of the uterus.
**Principle rules of Treatment**

1- Evacuation of the uterus.
2- Susceptibility of the infectious agent to the drug used.
3- Concentration and number of times the drug is used.
4- Exposure of entire endometrium, cervix, and vagina to the drug
5- Systemic antibiotics
6- IV dextrose, oral propylene glycol
7- IV hypertonic saline?
8- Intruterine lavage ????
9- Intruterine antibiotics ????
10- Hormonal treatment ????

**Drugs**

Drugs administered into the uterus after parturition are often rendered ineffective because of the nature of the intrauterine environment.

On the other hand, drugs that increase uterine motility – Oxytocin, ergot derivatives, calcium-have shown, at best, a limited benefit.

- The aim of therapy should be to prevent the adverse effects of postpartum endometritis.
  - Intruterine antibacterial therapy (in the form of an intruterine bolus) does reduce putrefaction and the disagreeable odour associated with retained placenta.
INFERTILITY IN CATTLE

CAUSES LEADING TO INFERTILITY AND STERILITY

By
Prof. Dr. Ayoub

A- Congenital and hereditary causes.
B- Hormonal causes
C- Pathological causes
D- Environmental and nutritional causes
E- Infectious causes (see Andrology Notes)

A- CONGENITAL OR HEREDITARY CAUSES OF INFERTILITY OR STERILITY
I- INTERSES OR HERMAPHRODISM.
II- FREEMARTINISM.
III- HYPOPLASIA OF THE OVARIES.
IV- OVARIAN APLASIA.
V- WHITE HEIFER DISEASE AND ARREST IN THE DEVELOPMENT OF THE MUELLERIAN SYSTEM.

B- HORMONAL CAUSES OF INFERTILITY

1- Ovarian cysts.
2- How to Diagnose Cyst in Cows.
   a- Rectal examination and findings.
   b- Types of ovarian cysts.
3- Etiology and Associated Factors.
4- Treatment
   a- Spontaneous Regression.
   b- Manual Rupture.
   c- Drug therapy
      1- Anerior pituitary extracts (APE)
      2- Human chorionic gonadotrophin (HCG)
      3- Gonadotrophin releasing hormone (GnRH)

One of the following drugs could be used for the
treatment:
GnRH (cystorelin) 100 µg i.m or i.v
GnRH (buserelin) 10 µg im or i.v
If no response give
HCG 1000 0.u i.v 10,000 i.u i.m

Advantages to using GnRH
Treatment Responses.
Prostaglandin therapy.

Delayed Ovulation
Anestrum (Failure of Estrus)
Definition
1- after parturition
2- following service when conception does not occur.

Class 1: Cows shown on rectal examination to have a corpus luteum present in one of the ovaries.
1- Anestrus due to pregnancy.
2- Anestrus due to retained or persistent corpus luteum
   a- Retained C.L. associated with early embryonic death.
   b- Retained C.L. associated with gross uterine pathology.
   c- Retained C.L. not associated with uterine pathology
3- Anestrus due to subestrus or "silent" heat
Predisposing factors
4- Anestrus due to unobserved heat.
How can you differentiate between cows approaching estrus and those just over?
By using rectal examination

5- Anestrus due to a cystic C.L.
its effect on a normal fertility treatment.
Class II: Cows having smooth inactive with ovaries with no functional C.L. palpable per rectum
   a- Anestrus due to smooth inactive ovaries
      Vaginal examination
   b- Cystic ovaries
   c- Miscellaneous conditions Prognosis.

Treatment
5- Treatment of inactive ovaries.

C- PATHOLOGICAL CAUSES OF BOVINE INFERTILITY

OVARY

1. OVARIAN TUMORS
2. OVARITIS (OOPHORITIS)
3. PAROVARIAN CYSTS

OVIDUCT

1- SALPINGITIS
2- HYDROSALPINX
3- PYOSALPINX
4- OVARIO-BURSAL ADHESIONS
PREVENTION OF THE PATHOLOGY OF OVIDUCTS, OVARIAN BURSA AND OVARY

UTERUS

1- ENDOMETRITIS

DEFINITION

CAUSES

SYMPTOMS

TYPES

<table>
<thead>
<tr>
<th></th>
<th>E1</th>
<th>E2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catarrhal endometritis from the 1st degree</td>
<td>Catarrhal endometritis from the 1st degree</td>
</tr>
<tr>
<td>1. Animal</td>
<td>Repeat-breeder</td>
<td>Repeat-breeder</td>
</tr>
<tr>
<td>2. Estral mucus</td>
<td>a) increased estral mucus</td>
<td>c) Turbid crusts</td>
</tr>
<tr>
<td></td>
<td>b) Clear</td>
<td>d) increased estral mucus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e) Discharges in non-estral animals</td>
</tr>
<tr>
<td>3- R.E.</td>
<td>a) Normal uterus</td>
<td>Uterus and cervix are enlarged and hard</td>
</tr>
<tr>
<td></td>
<td>b) Normal cervix</td>
<td></td>
</tr>
<tr>
<td>4- V.E - cervical canal - secretions - m.m</td>
<td>Opened</td>
<td>Opened</td>
</tr>
<tr>
<td></td>
<td>Clear</td>
<td>Turbid</td>
</tr>
<tr>
<td></td>
<td>Slightly congested</td>
<td>- More congested</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- mild severe cervicitis</td>
</tr>
<tr>
<td>5- Treatment</td>
<td>May heat spontaneously</td>
<td>- Do not heat spontaneously</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Use one of the methods of treatment of endometritis</td>
</tr>
</tbody>
</table>
TREATMENT OF ENDOMETRITIS

I- Intra-uterine infusion of antibioticca
II- Intra-uterine infusion with non-antibiotical (chemical disinfectants)
   1- Iodine
   2- Lotagen (4%)
   3- Povidone-iodine
   4- Dichloroxylenol

3- E3 OR METRITIS OR PURULENT ENDOMMETRITIS

DIAGNOSIS

1- History
2- R.E.
3- V.E.

TREATMENT

1- Prophylactic measures.
2- Curative treatment
   A- Pus evacuation
      1- Liquid Pus.
      2- Dry or inspissated pus.
   B- Broad spectrum intra-uterine antibiotics.
   C- Treated by one the methods of treatment of endometritis.
   D- Sexual rest.

4- PYOMETRA E4

definition.

Types of pyometra

a- Typical or closed or cortical pyometra.
b- Atypical or opened or pre-coital pyometra
Prognosis of pyometra

The prognosis depends upon:

1- Duration.
2- Type of M.O.
3- Quantity of pus.

Diagnosis

I- History
II- Clinical signs and symptoms
III- R.E.
IV- V.E.

Differential diagnosis

TREATMENT:

I- Treatment with conventional methods.

1- Enucleation
2- Infusion of the uterus.
3- Injection of estrogens.
4- Sometimes

II- Treatment with prostaglandin.

PROPHYLACTIC MEASURES IN ENDOMETRITIS

CERVIX

I- Cervicitis
II- Cysts of the cervix (Nabothian cysts)
III- Complete stenosis or obstruction of the cervix

D- ENVIRONMENTAL CAUSES OF INFERTILITY

A- Nutrition
Underfeeding
Hunger sterility
Definition of underfeeding
Effects of overfeeding
THE REPEAT BREEDER COW

ETIOLOGY

I- FAILURE OF FERTILIZATION

- Obstruction of the Oviduct.
- Developmental defects.
- Abnormalities in Ovulation.
- Inability of the Ova to Become Fertilized.
- Inability of the Sperm to Fertilize.

These chromosomal changes are:

a- Stickiness of the chromosomes.

b- Multiple spindles.

II- EARLY EMBRYONIC DEATH

CAUSES.

1- Congenital or Genetic Defects of the Fertilized Ova or Embryos.
2- Disease or Infection of the Fertilized Ova or Embryos.
3- Disturbed or Abnormal Environment of the Oviduct and Uterus.

The Abnormal or Inflammation of the Endometrium.

4- Infection or inflammation of the endometrium.
5- Hormonal disturbances.
6- Nutritional causes.
7- Lethal factors.
Reproductive Herd Health Herd Health Program
By Prof.Dr. Mohammad Bahgat Noseir
Professor of Theriogenology
Faculty of Veterinary Medicine
Alexandria university

Reproductive Herd Health Programs in Water Buffalo
- Buffalo population
- Features with and against buffalo breeding
- A model for breeding program
- Comparative values for measuring fertility
- Manage mental factors needed for keeping normal fertility and for building a good reproductive herd programs in cattle and buffalo:
  - Feeding plan
  - Heat influence and control
  - On--field milk progesterone assay

WATER BUFFALO
- Buffaloes have been domesticated for over 5000 years

World buffalo population
- 128 million in 1982
  - 158 million in 2000
In Asia 95-96% (153 million) [53% in India only]

Water buffalo types
I- Swap buffalo (Bubalus Carabensis) (48 chromosomes) From India to Philippines.
II - River buffalo (Bubalus Bubalus) (50 chromosomes) From India to Egypt and Europe.

Average annual increase in population rate:
During last decade:

India (880,000) 1.1 % (82 million)
Pakista 4.7%
Bangladesh 5.7 %
Nepal 2.1 %
Sir Lanka - 0.3 % negative growth rate
China 1.6 %
Thailand - 3.4 % negative growth rate
Philippines - 1.3 % negative growth rate
Malaysia - 2.3 % negative growth rate
Indonesia 3.0 %
Vietnam 2.3 %
Egypt ----- 

Features with buffalo breeding
_ Milk production (a distinctive Mozzarella)
_ Meat production
_ Efficient converter
_ Socio-economic security
_ Resistance to parasites
_ Enrich soil fertility
Features against buffalo breeding

* Poor breeder

Reasons

• Poor feeding
• Poor estrus detection
• Delayed puberty
• Longer gestation
• Delayed onset of 1st PP estrus
• Long days open
• Long calving interval
• Poor milk production
• Poor calf production
• Seasonality of breeding

Age of Puberty in Buffalo

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Breed</th>
<th>Puberty (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gorbelik</td>
<td>1935</td>
<td>Azerbeij</td>
<td>24-36</td>
</tr>
<tr>
<td>Marsh &amp; Dawson</td>
<td>1948</td>
<td>Maly</td>
<td>36</td>
</tr>
<tr>
<td>Baradat</td>
<td>1949</td>
<td>Cambodia</td>
<td>36</td>
</tr>
<tr>
<td>Hafez</td>
<td>1955</td>
<td>Egypt</td>
<td>13.5</td>
</tr>
<tr>
<td>Knapp</td>
<td>1956</td>
<td>Egypt</td>
<td>24-30</td>
</tr>
<tr>
<td>Zaki et.al.</td>
<td>1963</td>
<td>Egypt</td>
<td>22.3</td>
</tr>
<tr>
<td>Gharib et.al.</td>
<td>1964</td>
<td>Egypt</td>
<td>22-35</td>
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<tr>
<td>Salerno</td>
<td>1968</td>
<td>Italy</td>
<td>27.1</td>
</tr>
<tr>
<td>Kanaujia</td>
<td>1974</td>
<td>India</td>
<td>32.6</td>
</tr>
<tr>
<td>Taha</td>
<td>1974</td>
<td>Egypt</td>
<td>23.0 (well fed)</td>
</tr>
<tr>
<td>Ligda</td>
<td>1998</td>
<td>USA</td>
<td>18.0 (well fed)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28.0 (poor fed)</td>
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### Days open and calving interval in buffaloes

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Breed</th>
<th>Calving-conception Interval (days)</th>
<th>Calving Interval (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafez</td>
<td>1952</td>
<td>Egyptian buffalo</td>
<td>35.00</td>
<td>345</td>
</tr>
<tr>
<td>Vedagen</td>
<td>1955</td>
<td>Malayan buffalo</td>
<td>238.25</td>
<td>548</td>
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<tr>
<td>Ishaq</td>
<td>1956</td>
<td>Pakistan buffalo</td>
<td>168.00</td>
<td>478</td>
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<tr>
<td>Shalash</td>
<td>1958</td>
<td>Egyptian buffalo</td>
<td>141.10</td>
<td>451</td>
</tr>
<tr>
<td>Fowad &amp; Shokeir</td>
<td>1959</td>
<td>Egyptian buffalo</td>
<td>180-360</td>
<td>510</td>
</tr>
<tr>
<td>Afifi</td>
<td>1961</td>
<td>Egyptian buffalo</td>
<td>204.00</td>
<td>514</td>
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<tr>
<td>Schmidt et al.</td>
<td>1963</td>
<td>Egyptian buffalo</td>
<td>173.80</td>
<td>574</td>
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<tr>
<td>El-Sawaf et al.</td>
<td>1964</td>
<td>Egyptian buffalo</td>
<td>27.63</td>
<td>380</td>
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<tr>
<td>Ghanib et al.</td>
<td>1964</td>
<td>Egyptian buffalo</td>
<td>154-164.7</td>
<td>450</td>
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<tr>
<td>El-Wishy</td>
<td>1965</td>
<td>Egyptian buffalo</td>
<td>218-260</td>
<td>540</td>
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<tr>
<td>Goswami &amp; Kumar</td>
<td>1968</td>
<td>Indian buffalo</td>
<td>117.00</td>
<td>427</td>
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<tr>
<td>Fadzil</td>
<td>1969</td>
<td>Malayan buffalo</td>
<td>108.60</td>
<td>418</td>
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<tr>
<td>Ali</td>
<td>1974</td>
<td>Egyptian buffalo</td>
<td>75.13</td>
<td>385</td>
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<tr>
<td>El-Harini</td>
<td>1976</td>
<td>Egyptian buffalo</td>
<td>90-180</td>
<td>410</td>
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<tr>
<td>El-Sawaf &amp; Shalaby</td>
<td>1978</td>
<td>Egyptian buffalo</td>
<td>150-360</td>
<td>560</td>
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<tr>
<td>Barkawi</td>
<td>1984</td>
<td>Egyptian buffalo</td>
<td>60.5</td>
<td>370</td>
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<tr>
<td>El-Baghdady</td>
<td>1990</td>
<td>Egyptian buffalo</td>
<td>137.0</td>
<td>437</td>
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<tr>
<td>Ligda</td>
<td>1998</td>
<td>Egyptian buffalo</td>
<td>150.0</td>
<td>460</td>
</tr>
<tr>
<td>Usmani</td>
<td>2001</td>
<td>River buffalo</td>
<td>91.0</td>
<td>400</td>
</tr>
</tbody>
</table>

### Number of services per conception in buffaloes

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>No. of S/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hafez</td>
<td>1952</td>
<td>1.46 (cow)</td>
</tr>
<tr>
<td>Hafez</td>
<td>1955</td>
<td>4.25 (heifer)</td>
</tr>
<tr>
<td>Shalash</td>
<td>1958</td>
<td>1.41</td>
</tr>
<tr>
<td>Ahmed &amp; Tantawy</td>
<td>1959</td>
<td>2.10</td>
</tr>
<tr>
<td>Zaki et al.</td>
<td>1963</td>
<td>1.37</td>
</tr>
<tr>
<td>Singh &amp; Dutt</td>
<td>1964</td>
<td>1.75</td>
</tr>
<tr>
<td>Afifi</td>
<td>1967</td>
<td>1.5-2.9</td>
</tr>
<tr>
<td>Taha</td>
<td>1974</td>
<td>3.1</td>
</tr>
<tr>
<td>El-Baghdady</td>
<td>1990</td>
<td>2.7</td>
</tr>
</tbody>
</table>
Reproductive Herd Health Program

The utilized program is based on information from accurate records or computer programs

Objectives:
• Increasing replacements
• Increasing reproductive efficiency
• Lowering peri- and post-partum diseases
• Lowering culling rate

Replacements:
Mortality - Breeding - Calving

Reproductive efficiency:
Days open - Calving interval - S/C - Concept on rate - Heat detection rate

Culling rate:
Record culling - Selective culling

Peri- and Post-Partum diseases:
Milk fever - Ketosis - Mastitis - Anestrum - Repeat breeding

Parameters of buffalo reproductive efficiency

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Well Fed</th>
<th>Poor Fed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of 1st breeding</td>
<td>18-20 mo</td>
<td>24 mo</td>
</tr>
<tr>
<td>Age of 1st calving</td>
<td>28-30 mo</td>
<td>35-45 mo</td>
</tr>
<tr>
<td>Weight of 1st breeding</td>
<td>365 kg</td>
<td>400 kg</td>
</tr>
<tr>
<td>1st postpartum estrus</td>
<td>60 days</td>
<td>up to 400 days</td>
</tr>
<tr>
<td>Days open</td>
<td>100-150 days</td>
<td>up to 400 days</td>
</tr>
<tr>
<td>Calving interval</td>
<td>465 days</td>
<td>up to 700 days</td>
</tr>
<tr>
<td>Conception rate</td>
<td>50 %</td>
<td>60 %</td>
</tr>
<tr>
<td>In natural services</td>
<td>50-60 %</td>
<td></td>
</tr>
<tr>
<td>In A.I.</td>
<td>25-30 % (night mating and poor heat detection)</td>
<td></td>
</tr>
</tbody>
</table>
### Comparative Reproductive Herd Health Program

#### I- Replacement

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Buffalo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well fed</strong></td>
<td><strong>poor fed</strong></td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td></td>
</tr>
<tr>
<td>At Birth</td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>0- month</td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>&lt; 24 months</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>Average</td>
<td>&lt; 10%</td>
</tr>
</tbody>
</table>

**2- Breeding**

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Buffalo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of 1st breeding</td>
<td>15 mo</td>
</tr>
<tr>
<td>Weight of 1st breeding</td>
<td>360 kg</td>
</tr>
</tbody>
</table>

**3- Calving**

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Buffalo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of 1st calving</td>
<td>24 mo</td>
</tr>
<tr>
<td>Weight of 1st calving</td>
<td>500 kg</td>
</tr>
</tbody>
</table>

#### II- Reproductive efficiency

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Buffalo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well fed</strong></td>
<td><strong>poor fed</strong></td>
</tr>
<tr>
<td>1. 1st postpartum estrus</td>
<td>&lt; 45 d.</td>
</tr>
<tr>
<td>2. Service period</td>
<td>&lt; 70 d.</td>
</tr>
<tr>
<td>3. Days open</td>
<td>&lt; 80 d.</td>
</tr>
<tr>
<td>4. Calving interval</td>
<td>365 d.</td>
</tr>
<tr>
<td>5. No. of services/concept.</td>
<td>&lt; 2 (1.6)</td>
</tr>
<tr>
<td>6. Conception rate</td>
<td>60-65 %</td>
</tr>
<tr>
<td>7. Heat detection rate</td>
<td>80 %</td>
</tr>
<tr>
<td>8. Culling rate</td>
<td>&lt; 15 %</td>
</tr>
</tbody>
</table>
What should be done?
Should we improve buffalo breeding?
OR
Should cattle simply replace buffalo?

Improvement could be by:
- Keeping normal fertility indices
- Careful nutritional plan
- Avoiding heat stress
- Avoiding reproductive disorders possibly by progesterone assessment

How can you keep the parameters of fertility within normal values?
- Estrus detection (80%)
- Calving conception interval (85 days)
- Conception rate (60-65%)
- Culling rate (15%)
**ESTRUESTRUS**

**Signs :**
- Homosexual behavior.
- Translucent mucus (sitting animals), turns to turbid then dirty with the progress of estrus.
- Frequent urination.
- Silent heat: Incidence 50-60% in Egypt, and 15% in India.
- Estrus length: 12-36 hours in Egypt, and 24 hours in India.
- Time: Between 6 pm and 6 am.
- Mating: Mostly at night hours.
- Ovulation: 5-24 hours after the end of estrus signs.
- High conception: During hours of turbid mucus and mucus fern-like crystallization.

![Diagram of estrus signs in cows](image)

*Figure 3: Timing of insemination or natural service for cows in heat*
Seasonality of breeding
Breeding season: October to February.
Causes: low efficiency during hot months due to nutrition and heat stress.

Poor breeders causes:
- slow maturation.
- slow breeding after calving.
- Poor estrus detection.
- High incidence of silent heats.
- Matting frequent at night.
- Gestation is longer (310 days).
- low economy of 3rd world nations
- Poor feeding
- Poor management low economy of 3rd world nations

Scheme for diagnosis of infertility

* Anestrum
  - Inactive ovaries
  - Presence of CL
    - Subentries (silent heat & unobserved heat)
      - Persistent CL
    - Lu tea l cys t
    - Congen i ta l defec ts
* Delayed return to estrus
  - Ear ly embryon ic dea th
  - Chron ic endometri t i t is
  - Proges terone def ic iency
  - Spec if ic inf ec t ions
* Short estrus (fo l l icu lar cys t)
* Regular return to estrus
  - Infertile bull - management fault - failure of CL
  - delayed ovulation or inoculation
  - Infectious endometritis
Heat & Lactation Stress

Hypothalamus

CRH
(Corticotropin Releasing Hormone)

Direct inhibitory effect on hypothalamus by way of opioid neurons, reducing GnRH secretion and oxytocin thus influencing parturition and lactation

β-endorphin
- Directly influence gonadotrophin regulation

Ant. Pit.

ACTH
- Block preovulatory release of LH
- Suppress testosterone production in male

Adrenal Cortex

Gonads

Gonadotropins

- Reduce folliculogenesis
- Embryo implantation and sexual behavior
- Leydig cells produce β-endorphin that regulate its function
- Modulate FSH secretion & sertoli cell function

- Directly prevent GnRH secretion without diminishing the responsiveness of pituitary to GnRH.
- Glucocorticoid can act directly upon the pituitary gonadotrops to reduce gonadotrophin secretion (LH).
- Blocks the ability of GnRH to stimulate LH release.
- In bulls, there is inverse relationship between plasma glucocorticoids and testosterone secretion in response to exogenous LH.

Opioid Agonist: Morphin & Bremazocin (Sandoz) → increase LH secretion
Opioid Agonist: Naloxone & Quazadocine → decrease LH secretion
Effect of Heat Stress on Buffalo Breeding

Effect of heat stress

- Increase in \_endorphin assay
- Increase in progesterone assay
- Decrease in LH
- Increase in prolactin
- Increase in ovarian inactivity
- Prolonged days open

**In shaded buffaloes**

- Low cortisone
- Low blood glucose
- Low glucose at dawn and high in mid-day

**In non-shaded buffaloes**

- Increase in blood cortisone
- Increase in blood glucose

Blood progesterone level

**Low progesterone**

Follicular phase of estrous cycle
Follicular cysts
Postpartum period
Fast, early and complete uterine involution
Inactive ovaries after calving

**High progesterone**

Luteal phase of estrous cycle
Luteal cysts
Pregnancy
Delayed uterine involution with uterine pathology
Persistent CL

Therefore.......Progesterone determination is essential for assessment of reproductive process by:

- RIA of plasma and milk (expensive and slow).
- ELISA of milk samples (cheap and fast) [use of enzyme to label progesterone to replace radioactive isotope in RIA].
• Commercial ELISA kits are now available in the market for field milk progesterone assay.
• It is qualitative test for progesterone assay that provide information of high or low levels of progesterone.

**On-Field Milk Progesterone Assay**

- RIA: Expensive and slow
- ELISA: Cheap and quick

- Cost//Sample: 2-4 $
- Time of assay: 2-40 minutes
- Availability: 8 commercial kits
- Sampling: Fore or lasts tripping of milk

**Examples:**

**I- Test Tube ELISA Test:**
(Test tube containing antibody progesterone sites)

**Test:**
1. Milk sample added to the tube
2. Prog-enzyme complex (Alk. Phosphatase)
3. Incubate 1-15 min.
4. Empty and rinse the tube with water
5. Add enzyme substrate (break down by enzyme)
6. Add developer and incubate (1-5 min.)
7. Colour reaction occurs
8. Intensity of colour is inversely proportional to progesterone conc. in milk.

**II- LATEX Agglutination Test:**
(special glass slide containing a central groove)

**Test:**
1. Add equal amounts of ;
   tested milk + Antibodies + Progesterone coated beads
2. Result ;
   Smooth milk film ←High milk Prog.
   Grainy milk film ←Low milk Prog.
Manage mental and clinical uses of kits

- Estrus detection: High progesterone → Anestrum
  Low progesterone → Estrum
- Estrus prediction:
  Milk tested 17 to 23 postinsemination or postservice.
  Low progesterone → no conception → watch for expected estrus.
- Early pregnancy diagnosis:
  Milk tested 23 days postinsemination or postservice.
  High milk progesterone → pregnant.
  Low milk progesterone → return to estrus
  d. 23
d. 40 → E.E.M. (delayed return)
- Open cows:
  Long days open after calving > 150 days.
  Milk tested → Low progesterone → Inactive ovaries
  High progesterone → Uterine pathology
  Persistent CL

Breeding programs:
Milk from parturient cows > 60 days,
postpartum tested once weekly → High progesterone → give PGF2α
  AI at 72 & 96 hr fixed times →
  Low progesterone → give GnRH

- Cystic ovarian disease:
  Low progesterone → follicular cyst → give GnRH
  High progesterone → luteal cyst → give PGF2α
  Milk test 3 days post treatment with:
  GnRH → high progesterone → indicate efficient treatment
  PGF2α → low progesterone → indicate efficient treatment
Conclusion

Exensie utilization of RHP is essential from the economical point of view and for a sustained positive annual increase in growth rate of buffalo population.
RHP should be based on cost benefit analysis by estimating costs of expenses and returns.
Successful program needs the availability of the following services:

1. Recording Unit: using record or computer programs (e.g. DHA or HRS)
2. Small Lab Unit
   Diagnose is off diseases and progesterone assay
3. A..I. Unit
   Artificial insemination service and check of conception
4. Technical Supervision Unit
   • Watching duties of all labor activities
   • Suggesting incentives
   • Evaluation of reproductive indices
   • Designing programs for good management
Embryonic death:
- Cytolysis of zygote or disintegration of embryo (up to differentiation of organs buds).
- Resorbed or discharged at the next cycle.
- Repeat breeder.

Repeat Breeder

Definition
- Cow that had calved before.
- Is less than 10 years old.
- Has normal heat cycles.
- Has no palpable abnormalities.
- Has been breed 3 or more times and is not pregnant.

Etiology

Hereditary:
- Inbreeding.
- Gene translocation.
- Deficiency of uridine monophosphate synthetase, which is an autosomal recessive gene that results in fetal death in first 2 months of gestation.
- XXX Karyotype.
- Chromosome abnormalities.
- Fertilization failure.
- Abnormal embryo.
  i.e. “Summer heat stress“.
Environmental :

- Summer heat stress
  "high temperature, humidity and long light period".
  * One to two days embryos are affected by heat.
  * As blood flow to uterus decreases to shunt it to the rest of the body for cooling.
  * The uterine temperature rises, nutrients decrease and the waste products increase.
  * Result in abnormality and death of the embryo.

- Nutritional
  * vitamin E Deficiency.

Hormonal :

- A decreased GnRH or Luteinization.
- Release of PGF from inflammatory conditions such as mastitis which causes luteolysis and pregnancy loss.
- Inability to prevent PGF release causes returning of estrus.
- White heifer disease:
  Segmental aplasia uterus or oviduct.
- Salpingitis.
- Metritis and cervicitis.

Segmental aplasia uterus
Infectious agents:

- Viruses
  * BVD
  * IBR
  * Blue tongue.

- Bacteria
  * Bovine campylobacteriosis.
  * Ureaplasmas.
  * Mycoplasmas.

- Parasites
  * Trichomoniasis.

Bovine Campylobacteriosis (Vibriosis)

- Campylobacter fetus.
- Bull carriers.
- Coital transmission.
- Endometritis.
- Early embryonic death.
- Repeat breeding.

Bovine genital ureaplasmosis

- Ureaplasmas diversum.
- Bull carrier.
- Coital transmission.
- Granular valvovaginitis.
- Tiny fleshy bumps with abundant discharge.
- Endometritis and salpingitis.
- Early embryonic death.
- Repeat breeding.
Cervicitis

Bovine Mycoplasmosis
  Similar to Ureaplasmas

Bovine Trichomoniasis
  ➢ Trichomonas fetus.
  ➢ Bull carriers.
  ➢ Coital transmission.
  ➢ Endometritis.
  ➢ Embryonic death.
  ➢ Repeat breeding.

Bovine herpes virus 1
  “Infectious bovine rhinotracheitis“
  ➢ Bovine herpes virus 1.
  ➢ Respiratory infection IBR.
  ➢ Infectious pustular vulvovaginitis.
  ➢ Infectious pustular balanopothitis.
  ➢ Sometimes repeat breeding is the only symptom.
  ➢ The virus settles in the ovary from the blood stream.
  ➢ Early embryonic death.
Bovine viral diarrhea virus
- BVDV.
- Inhalation.
- Hematogenously settle in reproductive tract.
- Repeat breeding from failure of conception.

Blue tongue
- Early embryonic death.

Histopathology of Endometritis
- Denudation of lining epithelium.
- Moderate infiltration of neutrophils and lymphocytes in the lamina propria.
- Degeneration and necrosis of uterine glands epithelium.
- Dense infiltration of lymphocytes and plasma cells in the stratum compactum.
- Early fibroblastic proliferation around some endometrial glands.
- Periglandular and perivascular leukocytic infiltration.
- Some endometrial glands are distorted and cystic.
Gross pathology

- No gross lesions.
- The uterus in estrus.

Embryonic death with persistence of fetal membranes
(Placental mole)

- Embryo died and resorbed while fetal membranes persist and continue to grow.
- Cyst is filled by a mass of clear gelled fluid together with placental stroma.
- Cyst is referred to cystic placental mole.

Adventitial placentation

- Development of intercotyledonary primitive villous placentation as a compensation for inadequate endometrial placentomes.
- The process may be localized or diffused.
- The inadequacy may be:
  * Congenital.
  * Inflammatory destruction.

![Adventitial](image-url)
Placentation

*Hydramnios and hydrallantois*
- Excessive accumulation of fluid in the amniotic and allantoic sacs.
- Hydramnios is associated with malformations of fetus.
- Hydrallantois is associated with adventitial placentaion and twin pregnancy.
- Fetuses are dead when aborted or delivered and have anasarca and/or ascites.

*Prolonged gestation*
- Abnormally long gestation periods occur in cattle and sheep.
- Overpass normal by 2 to 17 months.
- Associated with anatomic or functional anomalies i.e. cyclopean, pituitary aplasia, ect.

**Etiology:**
* Genetic.
* Chemicals.
* Plant toxins
Fetal death

- Death of the fetus after differentiation
  The dead fetus may be:
  * Mummified.
  * Macerated.
  * Aborted.

Mummification of fetus

**Etiology:**
- Genetic diseases.
- Viral infection.
- Placental insufficiencies.

**Prerequisites for mummification:**
- Absence of bacterial infection.
- Closed cervix.
- Functional corpus luteum.

**Grossly:**
- Fluids reabsorbed.
- Fetal membranes adhere to desiccated fetus.
- The whole mass becomes brown or black and mucous and odorless.
- All that remain are dried skin and bones.
Macerated emphysematous fetus

Etiology:
- Bacterial and/or protozoal infection.
- Venereal infections as campylobacter fetus and Trichomonas fetus.
- Any non specific Endometritis.
- Pyometra.
- Putrefactive organisms cause fetal emphysema.

Grossly:
- Fetal bones resist maceration.
- Either discharged or retained in pus.
- Putrefied emphysematous fetus becomes distended with foul gas and crepitates.
- Fetal emphysema is fatal.
CONTROL OF REPRODUCTION IN SHEEP

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MS, PhD

Dept. Theriohenology, Assiut Univ., Assiut, Egypt

INTRODUCTION

- Sheep is the first domesticated mammals.
- Providing food and fiber for a growing word population.
- Rapid reproductive rate.
- Controlled reproduction can be important in saving time and labour.
- Using new technology permitting the annual output per ewe to be doubled.

Estrous Cycle

- Seasonal polyestrous: late summer-start spring.
- Subtropical breeds: continuous ovarian activity.
- Cycle: 14-18 days
- Estrus phase: 1-1.5 days, estrus behaviour, LH, ovulation.
- Luteal phase: 14-15 days, progesterone, CL.
- Ovulation: at the end of estrus.

Behavioral symptoms of estrus

- Estrus symptoms are not easy to detect in the ewe.
- Ewe remaining close to the ram and standing to be mounted.
- Vulva may be edematous.
- Mucus discharge from the vagina.

Control of estrus and ovulation

- Prostaglandin F2α and Analogues
- Progestagen - PG combinations
- Progestagens
- GnRH – PG - GnRH

Prostaglandin F2α and Analogues

- Only effective in cyclic ewes, not use during anestrous period.
- CL responsive to PG between day 4 and 14 of the estrous cycle.
- Recommendation: two PG injections 9-14 days apart.
- Dose: 15 mg Natural PG, 100µg cloprostenol analogues
- Estrus: 40h after PG.
- Ovulation: 70h after PG.
- Fertility: variable, less effective than progestagen pessaries.

Progestagen - PG combinations

- One way to overcome 2x PG.
- Short-term progestagen (7-9 d) + PG at withdrawal.
- Fertility: acceptable.
Progestagens
- Both in cyclic and non-cyclic ewes.
- Administared in several ways:
  - Oral
  - Injections
  - Intravaginal
  - Implant

The oral route
- Medroxyprogesterone acetate (MAP).
- 40-80 mg per sheep / daily / 16 days.
- Estrus: 58-90%, within 6 days.
- Fertility: 74%.
- Disadvantages: time + labour + cost.

Intravaginal sponge
- MAP or FGA.
- Intravaginal 12 days.
- PMSG (500 -750 IU) at sponge removal.
- Estrus: 36h after withdrawal
- Introduction of proven ram (1:10) 48h alter.

Technique of sponge insertion
- Place: against cervix.
- Dusting sponges with antibiotic.
- Sponges should never lubricated.
- Sponge loss: 0.5%.
- At withdrawal: some fluids.

Sponge Insertion
Sponge withdrawal

Progestagen without PMSG
- Ewe should be cyclic.
- Vary with the breed, age, and other factors.

Controlled internal drug releasing device (CIDR)
- Progesterone-impregnated silicone.
- Suitable for parous and ewe lambs.
- Plasma progesterone level increase rapidly.
- Withdrawal is not accompanied by the fluid discharge.

Controlled internal drug releasing device (CIDR)
- Estrus: 30h (earlier than MAP or CAP).
- Re-use:
  - Estrus 68%.
  - Fertility lower by 7%.
Estrus response and lambing outcome in relation to intravaginal treatment employed in anestrous ewes.

<table>
<thead>
<tr>
<th>Ewe treated</th>
<th>FGA</th>
<th>MAP</th>
<th>CIDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>%mated</td>
<td>98</td>
<td>97</td>
<td>95</td>
</tr>
<tr>
<td>%lambing</td>
<td>70</td>
<td>68</td>
<td>80</td>
</tr>
<tr>
<td>Litter size</td>
<td>1.63</td>
<td>1.91</td>
<td>1.71</td>
</tr>
</tbody>
</table>

Estrus response and lambing outcome in relation to intravaginal treatment employed in cyclic ewes

<table>
<thead>
<tr>
<th>Ewes treated</th>
<th>FGA</th>
<th>MAP</th>
<th>CIDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>%mated</td>
<td>100</td>
<td>92</td>
<td>88</td>
</tr>
<tr>
<td>%lambing</td>
<td>88</td>
<td>80</td>
<td>56</td>
</tr>
<tr>
<td>Litter size</td>
<td>2.05</td>
<td>1.7</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Fixed-Time Sheep Artificial Insemination
- ✓ Overcome ram : ewe ratio.
- ✓ Avoid instance of ram subfertility.
- ✓ making superior genetic merit.
- ✓ Regimes:
  ✓ Progestagen – PMSG Techniques (AI: 50-60 h after terminating treatment).

More Frequent Lambing
- ● Twice-yearly lambing or three lambings in two years is possible.
- ● Biological limits: Season, postpartum, Ovarian activity, Lactation, Suckling.
- ● Regimes:
  - Controlled Light environment
  - Controlled breeding (FGA sponges)
  - Adequate and controlled nutrition
  - Abrupt weaning
# Estrous cycle

**By**

Dr. Derar Refaat Ibrahim

**Definition:** the period between two successive estrous periods (heat).

Classification of animals according to the incidence all over the year:

1. Monoestrous animals:
   - Seasonal
   - Non-seasonal

2. Polyestrous animals:
   - Seasonal
     - Short day breeder (Ewe, Doe)
     - Long day breeder (Mare)
   - Non-seasonal

**Species variation in estrous cycle characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Ewe</th>
<th>Sow</th>
<th>Cow</th>
<th>Mare</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length of Cycle</strong></td>
<td>14-19 days (16)</td>
<td>17-22 days (19)</td>
<td>18-24 days (21)</td>
<td>16-24 days (22)</td>
</tr>
<tr>
<td><strong>Length of Estrus (FSH/LH ratio)</strong></td>
<td>24-36 hours (30)</td>
<td>48-72 hours (60)</td>
<td>14-24 hours (18)</td>
<td>2-10 days (6)</td>
</tr>
<tr>
<td><strong>Time of Ovulation</strong></td>
<td>At the end of estrus</td>
<td>Few hours before the end of estrus</td>
<td>6-12 hours after the end of estrus</td>
<td>1-2 days (before the end of estrus)</td>
</tr>
<tr>
<td><strong>Time of A.I.</strong></td>
<td>12-18 hours after onset of estrus (presence of ram)</td>
<td>16-24 hours after onset of estrus and again 24-8hrs later</td>
<td>7-18 hours (12) after onset of estrus</td>
<td>Second day and every other day in estrus</td>
</tr>
</tbody>
</table>

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**Anestrus**

Physiological (seasonal, lactational, pregnant, postpartum)

Pathological

**Proestrus (Day 18- Day 20)**

Tertiary follicle(s) and oocytes undergo final maturation.

- Estrogen levels increases
- Female becomes receptive
- Estrogen prepares uterus and oviducts for sperm transport and fertilization
- Estrogen initiates uterine changes for later embryo development

**Estrus (18 hours= Day 0)**

- Female in heat
- High estrogens cause LH surge
- LH surge causes ovulation
- LH surge initiates corpus luteum formation

**Metestrus (Day 1 - Day 6)**

- Estrogen levels have decreased
- Corpus luteum is forming
- Progesterone levels start to increase
- Progesterone begins preparing the uterus for the embryo
- Embryo partially develops in the oviduct and moves into the uterus

**Diestrus (Day 7 – Day 17)**

- Maximum corpus luteum size
- High progesterone levels inhibit final follicular development, ovulation and estrus
- Embryo continues to develop in the uterus
- Embryo signals the uterus it is present - no CL regression

If embryo is not present - uterus releases PFG2 to cause CL regression.

If CL regresses, progesterone in blood decreases and Graffian follicle(s) begin final development that occurs in proestrus for ovulation at estrus.

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Factors affecting estrus cycle:

1- Nutrition
2- Season
3- Temperature
4- Work
5- Age
6- Disease
Arborization
Glassy, viscous
One strand, shiny
Clear and has the
character of
Fernerization increased

During rectal palpation

- Uterus is turgid
- Presence of GF
Vaginal findings

Hyperemia, congestion
Viscous, red, slightly dilated
Rose shaped external os

Most characteristic features of estrus behaviour in different species:

Bufferloe
Bellowing (long deep bleating)

Mare
Frequent urination, winking, male acceptance (teasing)

Ewe
Seeking male, presence of ram is necessary for detection of estrus

She camel
Waggling tail, squatting most times

Teaser animal and what could be?
**Foal heat**  
**Split estrus**  
**Silent estrus**  
**Anovulatory estrus**  
**Prolonged estrus**  
**Irregular estrus**  
**Overt estrus**

**Estrous synchronization: Why**

1. Group females for parturition  
   a. Labor, Calving period  
   b. More uniform weaning weights.

2. Reduce time required for estrus detection.

3. Eliminate estrus detection with timed insemination:
   
   - **Prostaglandins: PGF2a**
   - **Lutalyse** - Natural compound 25 mg dose I.M.
   - **Estrumate** - Analogue 500 ug dose I.M.
   - **Prosolvin** - Analogue 15 mg dose I.M.

**Principle** - Regress active corpus luteum i.e., Day 6-17 corpus luteum. Estrus occurred 2-5 (72 hours) days after injection 60-65% of herd should respond to injection.

To get whole herd synchronized, give 2nd injection 11 days after 1st Cows responding to 1st injection have day 6-9 corpora lutea Unresponding cows now have day 6-17 corpora lutea
Reasons for variation of response.

Young and old corpora lutea may respond different Heifers react sooner than cows.
Animal may be pregnant - Abortion Females do not have a corpora luteum, i.e. are anestrus.

Use of progestagens for Estrus synchronization

Principle:
Maintain the cow under the influence of progesterone until corpus luteum regresses, remove progesterone - animal respond to progesterone with estrus. 2-5 days later.
**Administration:**
1. Injection
2. Feed (MAP 180 mg, CAP 10mg and MGA 1 mg/day) or PRID + PGF2 alpha.
3. Implant (Norgestomet)
4. Pessary or Control Internal Drug Release (CIDR)

**Synchromate B system:**
1. Inject 5 mg estradiol valerate & 3 mg norgestomet
2. Implant Norgestomet (Progestagen) 6 mg
3. Remove implant 9 days later.
4. Breed 48 to 60 hours later or 54 hours later.

Estradiol - Luteolytic to d 3-9 corpora lutea.

Norgestomet - Inhibits follicular maturation.
### Mare Seasonality

<table>
<thead>
<tr>
<th>Spring Transition Period (Variable Ovulation)</th>
<th>Estrous Period (Ovulatory Season)</th>
<th>Fall Transition Period (Variable Ovulation)</th>
<th>Anestrus Period (Non-ovulatory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb</td>
<td>Mar</td>
<td>Apr</td>
<td>May</td>
</tr>
</tbody>
</table>

**Age of puberty**: 18 - 24 m  
**Breeding at**: 3 years
Two large follicles on the right ovary

Another look at changes on the ovary
Estrous cycle

**Definition:** the period between two successive estrous periods (heat).

Classification of animals according to the incidence all over the year:

1- Monoestrous animals:
   - Seasonal
   - Non-seasonal

2- Polyestrous animals:
   - Seasonal
     - Short day breeder (Ewe, Doe)
     - Long day breeder (Mare)
   - Non-seasonal
Species variation in estrous cycle characteristics

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![Diagram of the estrous cycle of the mare](image)

Figure 3. The Estrous Cycle of the Mare (adapted by Jones and Troxel).
Figure 2. Hormone levels and corresponding ovarian activity in the estrous period.
Most characteristic features of estrus behaviour in different species:

**Buffaloe**
Bellowing (long deep bleating)

**Mare**
Frequent urination, winking, male acceptance (teasing)

**Ewe**
Seeking male, presence of ram is necessary for detection of estrus

**She camel**
Waggling tail, squating most times

Teaser animal and what could be?
Cervical changes during the estrous cycle. (1) Diestrus cervix 10 days after ovulation. (2) Onset of estrus. The cervix is swollen and beginning to open. The folds are less defined. (3) Towards the end of estrus, the cervix is swollen and relaxed. The folds hang down, appearing very vascular. (4) Pregnant cervix, very hard, tightly closed and covered with pasty mucus.
Incidence of multiple ovulation's

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Prediction of Ovulation

1. # of days in heat
2. Growth rate of largest follicle
   1. Average 3-5 mm/day
3. Size of largest follicle
4. Softness of preovulatory follicle
5. Ultrasound image

Fig. 7.
In the equine industry, twins are undesirable so that most workers in the equine field prefer to reduce the twin into singleton by crushing one of the twin before the final attachment with the endometrium.

Out of 3 twin cases found in the present study, 2 cases continued their pregnancy normally whereas one case failed to continue after the manual reduction of the twin during the present study.
Fig.1. Ultrasonic Characteristics of early pregnancy in thoroughbred mares. (A) 15 days pregnancy notice the echogenic lines on the dorsal and ventral locations (dorsal and ventral arrows) on the yolk sac; (B) 18 days pregnancy notice the Guitar-pick shape of the conceptus; (C) 21 days pregnancy notice the irregular form of the conceptus and the embryo can be seen as small echogenic dot (white arrow) in the ventro-medial aspect of the conceptual swelling; (D) 28 days pregnancy notice the development of the allantois (white arrow); (E) 35 days pregnancy notice the dorsal position of the embryo (white arrow) and (F) 60 days pregnancy, with the fetus recumbent on the ventral uterine floor.
Characteristics of the Conceptus

- Day 21-30: embryonic development
- Day 36: allantoic sac
- Day 40: umbilical cord
- DAY 45-150 - Firm attachment of allantochorion to uterine epithelium
- DAY 90 - Endometrial cups degenerate
- DAY 150 - Firm placental attachment

**Endometrial cup**
Fig. 1. Ultrasonic characteristics of the ovarian activity during early Pregnancy in thoroughbred mares during 15 (A), 18 (B), 21 (C), 28 (D), 35 (E) and 60 days of gestation (F). Only medium, large follicles (F) and the corpus luteum (CL) were considered while small follicles were neglected.
Milk composition

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<th>Fat</th>
<th>Protein</th>
<th>Lactose</th>
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<td>Mare</td>
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<td>1.9</td>
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<td>6.2</td>
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<td>Goat</td>
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Foal heat

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Many follicles grow up during the foal heat
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Estrous Cycle – 21 d
Most characteristic features of estrus behaviour in different species:

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Foal heat
## Foal Heat

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Pregnancy Determination
By
Dr. Derar Refaat Ibrahim

• Failure to come into estrus
• Ultrasound
• Rectal palpation
• PMSG detection in blood (45-140 days)
• Urinary estrogen after 120 days

Characteristics of the Conceptus

• Day 6: travel to uterus
• Day 12: fluid
• Day 6-16: high movement in uterus
– movement of embryo suppresses P4 release & maintains pregnancy
• Day 16: triangular shape and implantation

Characteristics of the Conceptus

• Day 21-30: embryonic development
• Day 36: allantoic sac
• Day 40: umbilical cord
• DAY 45-150 - Firm attachment of allantochorion to uterine epithelium
• DAY 90 - Endometrial cups degenerate
• DAY 150 - Firm placental attachment
TEN FACTORS INFLUENCING PREGNANCY & PREGNANCY LOSS PER CYCLE

- MARE AGE
- BARREN REPRODUCTIVE STATUS
- EARLY BREEDING DATE
- LATE BREEDING DATE
- BREEDING FREQUENCY
- PROSTAGLANDIN FACTOR
- UTERINE CULTURE & CYTOLOGY
- EFFECT OF SEMEN EXTENDER
- POST-BREEDING ANTIBIOTIC INFUSIONS
- TWINS

Incidence of multiple ovulation's

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Seasonality

- Seasonally polyestrus
- Physiologic breeding season
  - April-October
- Winter anestrus
  - ~80% of mares cease ovarian activity during winter months
% Mares ovulating  % Mares in estrus

Increasing day length

Neuropathway

Decreasing melatonin

Increasing GnRH

Increasing gonadotropins

Receptors in eye

Pineal gland

Hypothalamus

Anterior pituitary

Ovaries

Decreasing day length

Neuropathway

Increasing melatonin

Decreasing GnRH

Decreasing gonadotropins
# Estrous Cycle – 21 d

**Estrous Cycle**

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
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<tr>
<td>30</td>
<td>31</td>
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**Follicular Development & Ovulation**

- Anterior Pituitary – FSH - follicular growth
- Pituitary – LH – maturation of follicle & ovulation

**Estrogen**

- Follicles reach 20-25 mm in diameter, secrete estrogen.
  - Estrus activity
  - Relaxation of cervix
  - Stimulates smooth muscles in tract for increased contractions to transport sperm & ovum.
  - Affects pituitary gland to inhibit further secretion of FSH & stimulates release of LH.

**Prediction of Ovulation**

- # of days in heat
- Growth rate of largest follicle
  - Average 3-5 mm/day
- Size of largest follicle
- Softness of preovulatory follicle
- Ultrasound image

**Corpus Luteum Formation**

- Secretes progesterone.
- Duration of luteal function is ~14-16 days
Manipulation of the Open or Post-foaling Broodmare

- Monitoring Issues
  - Ovulation prediction
  - Semen quality (including longevity)
  - Mare Uterine Defense Mechanism (UDM) problems
Manipulation Methods
• Artificial lighting
• Shortening late transition
• Inducing ovulation
• Estrus synchronization
• Estrus synchronization & ovulation induction

Progesterone or related compounds
• Normalization of estrus
• Regulation of estrus
• Estrus synchronization
• Long-term suppression of estrus
• Delaying foal heat
• Pregnancy maintenance

Use of PGF2a
• Shorten the interval between estrous periods
• Treatment of a maintained CL
• After foal heat
• Estrous synchronization

PGF2a
• Estrumate
• Lutalayse
• Stage of cycle – Corpus luteum has to be at least 5 days old
The larger the follicle prior to treatment, the shorter the post-treatment estrus

Use of PG’s for induction of abortion

• Before 35 days of pregnancy
  – One injection
• 35-100 days of pregnancy
  – Daily injections until mare aborts
• After 100 days of pregnancy
  – Risky to the mare

Prostaglandin vs. Progestins

• PGF$_2$α
  – Lyse CL
  – Induce estrus
  – End pregnancy
• Progestins
  – Produced by CL
  – Takes mare out of estrus
  – Sustains pregnancy

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Shortening Late Transition

• Progesterone administration?
  – Regu-mate (altregonest): 1ml/110 lbs BW
• HcG given with a ≥35 mm follicle & uterine edema may result in earlier ovulation

Inducing Ovulation

Cycling mare

- hCG
  - At least day 2 of heat
  - >35 mm follicle
  - Endometrial folds
  - 1000-3000 U hCG
  - IV
  - Interval to ovulation – 36
- Ovuplant implant

Days to Ovulation

Estrus Synchronization

• Note: The luteal phase is uniformly shortened, but ovulation varies widely.
• Single & double prostaglandin injections

Estrus Synchronization
Single Prostaglandin
Randomly Cycling

• Response rate of ~ 50% where they come into estrus in 2-4 d & ovulate in 7-9
**Estrus Synchronization**  
*(Double Prostaglandin)*  
*Randomly Cycling*

- 1st injection (50% have CL between days 5-15)  
- Wait 14 days  
- 2nd injection about 80% will respond  
- Ovulation still variable

**Estrus Synchronization**  
*Progesterone (Regumate) Administration*

- Produces artificial CL  
- The natural CL from the last ovulation will regress while the mare is on Regumate if given long enough (14-15 d)  
- Incompletely blocks ovulation. Give prostaglandin  
- Wide range of follicles at end of treatment  
- Estrus average 4-7 d with ovulation at 7-12 d  
- Give prostaglandin if administered for a shorter period

**Estrus Synchronization & Ovulation Induction**

- 10 mg estradiol plus 150 mg progesterone in oil injected daily for 10 d  
- Prostaglandin given on 10th d  
- HcG on day 18, breed day 19  
- Or Give HcG when follicle ≥ 35 mm
**Estrus Synchronization & Ovulation Induction**

**Postpartum Ovulation**

- 6-14 days
- SEASON EFFECT
  - Length of estrus
  - Interval to ovulation
  - Both decrease with increased day length

**Post-Foaling Mares**

- 37-74%
- Lower conception rates if ovulation occurs prior to day 10
- No decrease in fertilization
- No decrease in oviductal transport
- Decrease in maintenance of pregnancy

**Foal Heat**

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**Criteria Mares Should Meet In Order to Be Bred During Foal Heat**

- Delivery of foal without significant difficulty.
- Pass placenta within 3 hrs after birth
- A healthy foal that stands and nurses within 2 hr.
- A cervix free from bruises & abnormal discharges.
- A uterus significantly reduced in size, without fluid accumulations.

**Post-Foaling Mare**

-Delay Foal Heat-

- Regumate for 8-15 d, with prostaglandin given at end of treatment
- Ovulation follows in 7-12 d
- Time savings?

**Post-Foaling Mare**

-Delay Foal Heat-

- Progesterone & estrogen injections
  Administer for 2 d beginning on day of foaling, or a double dose on the day of foaling. Ovulation delayed past day 10 in Preliminary trials.

**Post-Foaling Mare**

-Shorten Interval to Next Estrus-

- If mare ovulates before d 10 or is abnormal (intrauterine fluid), give prostaglandin 5-7 d after ovulation
- Saves ~ 1 wk
Old vs Young

• Reduced pregnancy rates, higher EED
• Fewer oocytes/embryos collected
• Oviductal embryos smaller & of reduced quality
• Uterine embryos - reduced collection rates and quality, delayed development

Age

• 15-20 years
  – shorter follicular phase
  – smaller follicles
  – more double ovulation's

• 20+ years
  – longer follicular phase
  – intermittent ovulation's
  – failure to ovulate

Mare Evaluation

• Before Breeding Season
  – Speculum
  – Palpated
  – Ultrasound
  – Hormonal profiles – progesterone, estrogen, throxin

Uterine Evaluation

• Culture
  – Bacteria
• Cytology
  – Cells, bacteria
• Biopsy
  – Cells, scar tissue, glands
• Ultrasonography
Ultrasonography

• Fluid
  – Inflammation, infection
  – Urine
• Cysts
• Air
• Foreign bodies

Uterine Biopsy

• Category I – No pathological changes and should be of normal fertility
• Category II – Inflammatory changes severe enough to decrease fertility and may be accompanied by fibrosis
• Category III – Drastically reduced fertility. Uteri may be incapable of supporting fetal development.

Uterine Treatments

• Lavage
  – Large volumes of echogenic fluid
• Antibiotics
  – Infection
• Assist clearance
  – Oxytocin
  – Prostaglandins

Infertility in the Mare

• Anestrus
  – Season
  – Stress
  – Nutrition
  – Lactation
  – Pathology
  – Age
  – Behavior
Ovary

• No follicular growth
• Ovulatory failure
• Oocyte quality
• Chromosomal abnormalities

Oviduct

• Blockage
• Infection/inflammation
• Failure to pickup oocyte
• Poor environment

Uterus

• Inflammation
• Infection
• Fibrosis (scar tissue)
• Poor environment
• Mechanical

Endometritis:
Predisposing Factors

• Poor perineal anatomy
• Trauma (parturition or breeding)
• Inadequate hygiene
• Failure of uterine defense mechanisms (especially uterine motility/clearance)

Endometritis:
Treatment

• Correct predisposing factors
• Caslick’s procedure
• Improved hygiene/breeding techniques
• Uterine lavage/antibiotics
• Oxytocin to enhance clearance
Endometrial Fibrosis

- Scar tissue deposition
- Consequence of inflammation and/or age
- Permanent & irreversible change
- Diagnosed by biopsy

Endometrial Cysts

- Obstructed/dilated lymphatics
- Common in older mares
- Risk to pregnancy is low
- Confused with pregnancy on ultrasound

Infectious Infertility in Mares

- **Signs**
  - Irregular estrus cycles
  - Anestrus
  - Matted tail hair & crusty hair on hindquarters
  - Failure to conceive
  - Visible, slimy milky or creamy white exudate on vulva, tail, inner thighs, vaginal floor
  - Red mucus membranes

*Cervicitis may lead to repeat breeder*
Granulosa theca cell tumor in mare

Male pseudohermaphrodite goat

True hermaphrodite horse
A. Gonadless conditions or Ovarian Aplasia

- This is a rare condition when one or both ovaries are absent.
- It is caused when the gonadal ridge does not form correctly.
- Palpation is the best diagnostic method.
- There may be partial aplasia, when only one ovary does not form.

Hermaphroditism: Definition and Causes

Types of Hermaphrodite

- True Hermaphrodite
- Pseudohermaphrodite

It may be:

- Bilateral
- Unilateral
- Lateral

Lesions and Symptoms

- Male pseudohermaphrodite goat
- True hermaphrodite horse

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**Freemartin**

- A freemartin is a heifer born twin to bull. 90% are sterile.
- It is caused by a chimeric condition where hematopoietic cells intermingle in utero between the fetuses. This results in XX and XY cells present in a freemartin.

- Partial expression of Wolffian duct stimulating factor from male Y chromosome inhibits the female gonad.
- MIF (Müllerian inhibition factor) from the male cells prevents Müllerian duct formation, so no uterus forms.

**Clinical Signs**

- These animals often have a masculine steer-like appearance.
- They may have a small vulva and long vulvar hairs.
- Usually the external signs of a freemartin are noticed by the producer, so the ones you will examine as anestrus heifers will probably have normal external signs.

**Diagnosis**

- The Fincher pencil test' checks the vaginal depth.
- In normal animals you can insert the pencil. In abnormal heifers the tube will only go about 7.5 cm into the vagina. This test is only for young heifers, and age can play a big role in how deep the vagina is.
- If they are old enough, palpation is the way to go. These animals have no ovaries, uterus, or vagina.
- A karyotype checks for the XX and XY cell mixture in the blood. It can be run in animals of any age, and may be cost effective if the cost of raising the animal to maturity is considered.

**Ovarian Hypoplasia**

In ovarian hypoplasia, one or both ovaries are smaller than normal.
- This is a recessive trait in certain breeds of both beef and dairy cattle in Sweden, England and Denmark and is caused by a single autosomal recessive gene with incomplete penetration or in monosomy cases.
- Lesions, symptoms and clinical findings.
- Diagnosis and treatment
Hypoplasia

may be:

- Complete
- Incomplete

- Unilateral
- Bilateral

Free martin embryos

Vaginal Patency tool

Paraovarian cyst

Vestigues of the Wolffian duct system Seldom interfere with eproduction and can be removed manually

mare  Camel
Physiology of fert.

By

Dr. Derar Refaat Ibrahim

Structure of the follicle
Oogenesis

Diagram showing the process of oogenesis:
- **Cogonium**
- **Primary Oocyte**
  - **First Meiotic Division**
    - **2n**
    - **4n**
    - **Secondary Oocyte**
  - **Second Meiotic Division**
    - **2n**
    - **Polar Body**
    - **Polar Bodies (wasted material)**
- **Mature Ovum**
metaphase plate

Spermatogenesis

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Gamete Transport - Ovum

• Most optimal place for fertilization is the middle third of the fallopian tube
• At ovulation, cilia in fallopian tube are beating toward uterine lumen.
• Under estrogen influence cilia keep ovum in distal area; under progesterone influence transport toward uterus is enhanced.

Gamete Transport - Sperm

• Transport is facilitated by muscular contractions of female tract with assistance from oxytocin and prostaglandin
• Migration through ultrachannels in cervical mucus occurs
• Fluid flow in oviduct is toward the ovary
Factors facilitating fertilization

A- Capacitation
B- Meeting of the ovum and sperm
C- Acrosome reaction
D- Fertilizin-Antifertilizin reaction

• There is rapid transport into the ampulla by fimbria and ciliated cells
• Factors involved in meeting of gametes
  – the sperm speed
  – the sperm concentration around the ovum
  – the corona radiata

Events of Fertilization

• Penetration of cumulus cells (hyalurindase)
• Penetration of zona pellucida (Zona lysin)
• Penetration of vitelline membrane and activation of ovum
• Zona reaction
• Formation of pronuclei
• Development of pronuclei
• Formation of chromosome group
• Union of two chromosome groups
Abnormalities of fertilization

A. Incomplete maturation of the ovum (polygyny)
B. Polyspermy
C. Gynogenesis or Androgenesis
D. Wandering of the ovum
E. Superfecundation
F. Superfetation

**Polyspermy**
Twinning

**Definition**
1. Monotocus or uniparous
2. Polytocus or multiparous

**Factors affecting twinning**
1. Environmental (season, Age, Early p.p. breeding, sire, hormonal treatment)
2. Hereditary (breed and family)

**Types**
1. Monozygous (identical)
2. Dizygous (non identical or fraternal)

**Incidence**
Pathological affections
By
Dr. Derar Refaat Ibrahim

A. Measures of reproductive efficiency in mare

• Reproductive efficiency has been determined by various parameters:
  1. Conception rate
  2. Pregnancy rate
  3. The number of matings per conception
  4. The first service conception rates.

• The optimum expected reproductive efficiency in mares is: 80% conception rates over the season;

• 50% conception rate per estrous cycle; and 70% live foal crop.

B. Causes of Low Reproductive Efficiency in Horses

1. Selection

2. Domestication
   a) The stallion is kept separate from the mare except at mating.
   b) Mares are confined to stables for long periods (days and weeks) covering estrus.
   c) Nutritional deficiencies.
   d) Inadequate housing may expose mare to risks of draughts, poor ventilation, and variations in temperature and light, which will impair reproduction.
   e) Universal Birthday of January 1st

C. Reproductive Problems in the Mare

1. Functional and hormonal abnormalities
   a. Abnormalities of estrus behavior
   b. Ovulation problems
   c. Failure to maintain pregnancy
   d. Infections.
   e. Lastly, pathological conditions such as ovarian hypoplasia, and ovarian neoplasms either prevent expression of estrus or render the mare infertile.
D. Causes of Reproductive Failure in Maiden Mares

1. Absence of estrus (Delayed puberty, congenital anomalies, intersex, anabolic steroids)

2. Persistent/imperforate hymen

3. Difficult Breeders: are attributed to inexperience or being frightened by strange horses, result in loss of breeding opportunities

C. Causes of Reproductive Failure in the Broodmare

1. Prolonged Periods in Estrus due to
   a. Persistent estrus due to a large persistent follicle (transitional period) split estrus
   b. Presence of two follicles and double ovulations may also be associated with prolonged periods in estrus.
   c. Persistent estrus associated with presence of several small follicles in the ovaries (early breeding season).
   d. The fourth ovarian problem characterized by prolonged periods in estrus is estrogen producing granulosa cell tumor

2. Anestrus

3. Reproductive failure due to ovulating problems.

D. Reproductive Failure in the Postpartum Mare

1. Mare acyclic

2. Anestrus in the postpartum period may also be associated with:
   • A. Pregnancy—mare was bred on foal heat.
   • B. Psychological anestrus—where mare is exhibiting normal ovarian changes, but estrus is Covert.
   • C. Anestrus may be due to the presence of a functional CL.
Pathological affections in the mare

Mare may be:
1- Resistant
2- Susceptible.

Susceptibility increased with:
Age – Parity – poor perineal conformation - feeding

Foreign intruders may get way to the uterus during:
Breeding – foaling – post partum period – clinical examination

**Uterine Defense Mechanism:**
Two major components
1- Cellular reaction (neutrophil phagocytosis)
2- Mechanical evacuation (clearance).

**Uterine Causes of infertility in mares may be:**

1- Non infectious causes

A- Uterine hypoplasia
B- Uterine atrophy
C- Uterine luminal cysts
In old mares
D- Persistent mating – induced endometritis.

2- Infectious causes
A- Viral infections (Equine Coital Exanthema or genital horse pox) caused by equine herpes virus –3 characterized by pain during covering, vesication and ulceration of both vulva and perineum may extend with secondary infection to the uterus.

* It is sexually transmitted
* Symptomless carriers are possible
* Antibacterial creams or powders can be used in both stallion and mare.
* Natural mating must cease

B- Bacterial
Many different bacteria have been isolated such as:


Contagious Equine Metritis (CEM)
• An extremely contagious venereal disease. Stallion act as asymptomatic carrier.
• Unsanitary examination or application of unhygienic instruments during swabbing or AI. May be a source of infection

The disease caused by a gram negative microaerophilic coccobacillus (T. or Haemophyllum equigenitalis)

It is characterized by signs of acute endometritis, cervicitis and vaginitis with copious greyish discharge within 2-5 days of infection. It may develop into chronic form. Repeat breeder and irregularity of the cycle is the main complain
**Diagnosis:**
1- Isolation of the micro-organism on Amies transport medium supplement with charcoal then on chocolate blood agar and incubated at 5-10 % Co2 at 37 °C
Pin point sized grayish colonies
Swabs taken from clitoris and clitoral sinuses

**Treatment**
1- Penicillin 5-10 million I.U. daily for 5-7 days (IM)
2- scrubbing the clitoris and sinuses daily with chlorohexidine Nitrofurazone antiseptic.
3- Sinusectomy.
4- Uterine lavage (normal saline or distilled water or physiological solutions)
5- Intrauterine antibiotic infusion (according to the size of the uterus) Penicillin is the drug of choice
6- Antiseptics
7- Plasma infusion
8- Oxytocin and prostaglandins (effect, dose and adverse effects)

external genitalia, vaginal vestibule, fossa and clitoral areas are all washed with chlorhexidine scrub and packed with nitrofurazone ointment for 5 consecutive days.

**II. Cervical causes:**
1- Cervicitis
2- Cervical adhesions

**III. Vaginal and vulval causes**
1- Wind sucking or Pneumovagina
CASLIK Operation

A. Disinfection
B. Anesthesia
C. Strip removal
D. Other side
E. Suture or stapling
F. Removal after 7-10 days

Control and prevention

1- good mare and stallion management during covering (avoid unnecessarily matings)
2- sanitary help during normal and abnormal foaling
3- extreme hygienic measurements during gynecological exam.
4- proper application of A.I.
5- Caslik operation.

Normal follicle and CL

Healthy and diseased uterus

Normal pregnancy and endometrial cyst
Granulosa theca cell tumor in mare

hermaphrodite horse

Persistent hymen
Endometritis in mare
Pathological affections in the mare

By

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Inducing Ovulation

Cycling mare

• GnRH
  • At least day 2 of heat
  • > 35 mm follicle
  • Endometrial folds
  • 1000-3000 U hCG
  • IV
  • Interval to ovulation – 36 hours
• Ovuplant implant

Foal Heat

<table>
<thead>
<tr>
<th></th>
<th>Dry Mares</th>
<th>Lactating Mares</th>
</tr>
</thead>
<tbody>
<tr>
<td>At foal heat/first service estrus</td>
<td>62</td>
<td>37</td>
</tr>
<tr>
<td>At next following period</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>At later periods</td>
<td>12</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Do you know that:

- The most critical reproductive problem in our country is the increase of open days in our dairy cattle and buffalo.
- Ovarian inactivity is the major cause of this dilemma.
- Nutritional disorders are the milestone to solve the problem.
- Most of the hormonal treatments or any other approach is worthless without rectifying the nutritional status of the animal.
- The main green fodder used in our country (Barseem) is deficient in phosphorus.

Four major periods during which nutrition is crucial

- Before puberty
- Parturition
- Peak of Lactation
- Post partum period to rebreeding
- Effect of nutrition may be
• direct (some elements like phosphorus, Vit. E. and dietary energy that affect luteal function, spermatogenesis or folliculogenesis respectively) or
• indirect (gonadotropin, progesterone deficiencies and thyroid function).

![Production Cycle of the Cow Diagram]

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestation</td>
<td>Mid</td>
<td>60-90 days</td>
<td>Calving to</td>
<td>Breeding to</td>
</tr>
<tr>
<td></td>
<td>precalving</td>
<td></td>
<td>rebreeding</td>
<td>weaning</td>
</tr>
<tr>
<td></td>
<td>growth</td>
<td></td>
<td></td>
<td>growth</td>
</tr>
<tr>
<td></td>
<td>Prepare for</td>
<td>Regain wt</td>
<td>Repair Repro.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>lactation</td>
<td>loss</td>
<td>tract</td>
<td></td>
</tr>
</tbody>
</table>

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**Nutrition and Puberty**

- Age of puberty related to body weight
- Age of breeding
- Effect of malnutrition on pre-pubertal animal.
- Normal requirements for proper growth and maturation 1.5 lb/day for body gain.

**Nutrition, fertility and lactation**

**Feeding/Reproduction Factors**

1. Energy aspects
2. Impact of body condition score
3. Role of fat supplementation
4. Impact of protein
5. Mineral and vitamin considerations

**Body condition scores and animal appearance at each condition score.**

<table>
<thead>
<tr>
<th>BCS</th>
<th>Condition</th>
<th>Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emaciated</td>
<td>Shoulder, ribs and back are visible</td>
</tr>
<tr>
<td>2</td>
<td>Very thin</td>
<td>Some muscle, no fat deposits</td>
</tr>
<tr>
<td>3</td>
<td>Thin</td>
<td>Some fat deposits, ribs visible</td>
</tr>
<tr>
<td>4</td>
<td>Borderline</td>
<td>Foreribs not noticeable</td>
</tr>
<tr>
<td>5</td>
<td>Moderate</td>
<td>12th and 13th ribs not visible</td>
</tr>
<tr>
<td>6</td>
<td>Good</td>
<td>Ribs covered, sponginess to tailhead</td>
</tr>
<tr>
<td>7</td>
<td>Very good</td>
<td>Abundant fat on tailhead</td>
</tr>
<tr>
<td>8</td>
<td>Fat</td>
<td>Fat cover thick and spongy</td>
</tr>
<tr>
<td>9</td>
<td>Obese</td>
<td>Extremely</td>
</tr>
</tbody>
</table>
Influence of body condition on return to estrous cycles in beef cows.

<table>
<thead>
<tr>
<th>BCS</th>
<th>Postpartum interval, days</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>88.5</td>
</tr>
<tr>
<td>4</td>
<td>69.7</td>
</tr>
<tr>
<td>5</td>
<td>59.4</td>
</tr>
<tr>
<td>6</td>
<td>51.7</td>
</tr>
<tr>
<td>7</td>
<td>30.6</td>
</tr>
</tbody>
</table>

Percentage of cows cycling at various body condition scores

Body Condition and Fatty Liver

![Graph showing liver lipid concentration over time for thin and fat cows](image-url)
What Is Negative Energy Balance?

• Negative energy balance (NEB) is when the sum of the energy needs is greater than the amount of energy supplied to the cow.

• Cows in NEB make up the difference between energy needs and energy required by mobilizing body reserves (losing weight and body condition).

Typical Energy Balance for Transition and Early Lactation Dairy Cows

Early Lactation & Reproduction

• NEB has negative effects on both follicle and CL

• NEB reduces LH secretion Low LH results in smaller follicles

• NEB results in lower progesterone production by the CL at 2nd and 3rd ovulation

• Effects of NEB may take 40-60d to observe in reduced pregnancy rates
Indicators of Energy Balance

- Change in body condition score (BCS)
- Non-esterified fatty acids (NEFAs)
Summary

- Optimize DMI
- Minimize weight loss
- Control metabolic disorders

Feeding Fat Impacts on Reproduction

- Increase in the number of follicles of different class sizes
- Larger dominant follicle
- Increase conception rate (17%)
- Stronger heats (71% v 66% standing heat)

Role of Added Fat Improving Reproductive Performance

- Increase progesterone production or secretion
- Inhibition of prostaglandin production or release
- Reduce negative energy balance leading to:
  - Earlier return to estrus possible
  - Increase in fertility

Role of PUFA (Polyunsaturated Fatty Acids)

- Fish meal and oil seeds contain PUFA
- Linoleic acid inhibits prostaglandin levels
- Increases lifetime of corpus luteum
- Increase the size of corpus luteum
- Decrease in estradiol (reduces the role of prostaglandin)
Overconditioned Cows

- Have poorer reproductive performance
  - Longer period of negative energy balance
- Have higher incidence of:
  - Fatty liver
  - Metritis
  - Other metabolic diseases
- Have poorer total lactational milk yield

**Dry Matter Intake**

<table>
<thead>
<tr>
<th>Time</th>
<th>1(^{st}) lact</th>
<th>2(^{nd+}) lact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>31.0</td>
<td>36.5</td>
</tr>
<tr>
<td>Week 2</td>
<td>35.0</td>
<td>42.5</td>
</tr>
<tr>
<td>Week 3</td>
<td>38.0</td>
<td>46.5</td>
</tr>
<tr>
<td>Week 4</td>
<td>40.0</td>
<td>49.0</td>
</tr>
<tr>
<td>Week 5</td>
<td>41.5</td>
<td>52.5</td>
</tr>
</tbody>
</table>
Relationship of Milk Production to production Fact or Fiction?

Milk production increases 2 to 3% annually Conception rate with AI has declined from 66 to 40-50%
High producing cows may be cystic and difficult to breed

Crude Protein (CP) = Nitrogen x 6.25 Contains Protein & NPN

Available CP

Unavailable CP
• Mostly undigestible & excreted in feces

Rumen Degradable CP
• May be soluble or insoluble
• Used by microbes

Rumen undegradable CP
Largely insoluble and passes to small intestine

Digestible CP in intestines & supplies amino acids to cow
Undigestible CP in intestines & excreted in feces

High Dietary Protein

Amount

Degradability

Rumen
Bacterial CP
Amino Acids
Ammonia

Small Intestine
Bacterial CP
Amino Acids
Ammonia

Liver

Ammonia

Amino Acids → Ammonia
Ammonia → Urea

Blood Urea and Ammonia

Pituitary-Ovarian Axis
LH
Progestosterone

Uterine Environment
Toxic Effect on Gametes, Embryo

Immune System
Lymphocytes
Repro Disorders
Impact of Protein on Health

Recommended Concentrations of Protein for Dairy Cows

Days of Lactation

<table>
<thead>
<tr>
<th></th>
<th>0 - 21</th>
<th>22 - 100</th>
<th>101 - 200</th>
<th>201 - 305</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM Intake, lbs</td>
<td>40</td>
<td>52</td>
<td>49</td>
<td>42</td>
</tr>
<tr>
<td>CP, %</td>
<td>19</td>
<td>18</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>RDP, %CP</td>
<td>60</td>
<td>62</td>
<td>64</td>
<td>68</td>
</tr>
<tr>
<td>RUP, %CP</td>
<td>40</td>
<td>38</td>
<td>36</td>
<td>32</td>
</tr>
<tr>
<td>Soluble CP, %CP</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>34</td>
</tr>
</tbody>
</table>
Impact of Minerals

1- Phosphorous (P)

- Impact heat expression
- Improve conception rate
- Role in retained placenta

Phosphorous Strategies

- Accurately evaluate P levels in rations using wet chemistry
- Monitor blood levels if necessary
- Supply phosphorus in the appropriate amount

Zinc (Zn)

- Improve immune system
- Lower days open
- Maintain epithelial cells

Selenium (Se) (Antioxidant)

- Reduce retained placenta
- Increase conception rate
- Improve immune system
Concentrations of Se in Whole Blood and Plasma

<table>
<thead>
<tr>
<th>Whole Blood Status</th>
<th>Plasma µg/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>0.20 - 1.00</td>
</tr>
<tr>
<td>Good</td>
<td>0.19 - 0.16</td>
</tr>
<tr>
<td>Marginal</td>
<td>0.10 - 0.15</td>
</tr>
<tr>
<td>Deficient</td>
<td>&lt; 0.10</td>
</tr>
</tbody>
</table>

Other Minerals

- **Ca**
  - Related to P
- **Na and Cl**
  - Impact DMI
- **Cu and Zn**
  - Immune system
- **Mn**
  - Calf liveability
  - Conception
- **S and Co**
  - Rumen microbial growth

Vitamins

- **Vitamin A**
  - Maintain epithelium lining
- **Vitamin D**
  - Needed for P and Ca absorption
- **Vitamin E**
  - Reduce retained placenta
  - Increase conception
  - Avoid white muscle disease
Summary

• Review recommended levels based on the phase of lactation and gestation
• Trace minerals are supplemented
  – Assume none available in forage or grain
• Inorganic sources
  – Sulfates, carbonates, and chlorides are more available
• Organic minerals recommended
  – Zn & Cu

Fetal Growth Requirements

Fetal requirements increase substantially during the dry period
Glucose Needs and Supply for Transition Cows

![Graph showing glucose supply and demand](image)

Overton, 1998
Number of small and medium follicles in low, control and high energy diets fed she-camels

Calcium deposits on the placenta
Adventitious placenta (Vit. A deficiency)

Retained placenta (Vit. E and selenium)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Natural requirement</th>
<th>Natural source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>According the reproductive state</td>
<td>maize, wheat, oats, rice, grass; Yellow Corn; molasses; cotton seed; sunflower seeds; grass</td>
</tr>
<tr>
<td>Protein</td>
<td>13-16 % crude protein</td>
<td>clovers, beans, grass</td>
</tr>
<tr>
<td>Vit. A</td>
<td>400 IU/cow/day</td>
<td>Green fodder as carotene</td>
</tr>
<tr>
<td>Vit. D</td>
<td>6000-12000 IU/day</td>
<td>Feed additives</td>
</tr>
<tr>
<td>Vit. E</td>
<td></td>
<td>Feed additives</td>
</tr>
<tr>
<td>Calcium</td>
<td>&lt; 100g/head/day</td>
<td>Barseem (Ca:phosphorus ratio)</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.4% of ration on DMB</td>
<td>Feed additives</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.1 ppm</td>
<td>Feed additives</td>
</tr>
<tr>
<td>Iodine</td>
<td>0.5 ppm</td>
<td>Feed additives</td>
</tr>
<tr>
<td>Copper</td>
<td>0.1 ppm</td>
<td>Feed additives</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.1 ppm</td>
<td>Feed additives</td>
</tr>
<tr>
<td>Manganese</td>
<td>40 ppm</td>
<td>Feed additives</td>
</tr>
<tr>
<td>Zinc</td>
<td>40 ppm</td>
<td>Feed additives</td>
</tr>
</tbody>
</table>
### Examples of Inadequate or Excessive Dietary Nutrient Intake on Reproduction in Cattle

<table>
<thead>
<tr>
<th>Nutrient Consumption</th>
<th>Reproductive Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive Energy Intake</td>
<td>Low conception, abortion, dystocia, retained placenta, reduced libido</td>
</tr>
<tr>
<td>Inadequate Energy Intake</td>
<td>Delayed puberty, suppressed estrus and ovulation, suppressed libido and spermatozoa production</td>
</tr>
<tr>
<td>Excessive protein intake</td>
<td>Low conception rate</td>
</tr>
<tr>
<td>Inadequate protein intake</td>
<td>Suppressed estrus, low conception, fetal resorption, premature parturition, weak offspring</td>
</tr>
<tr>
<td>Vitamin A deficiency</td>
<td>Impaired spermatogenesis, anestrus, low conception, abortion, weak offspring, retained placenta</td>
</tr>
<tr>
<td>Phosphorus deficiency</td>
<td>Anestrus, irregular estrus</td>
</tr>
<tr>
<td>Selenium deficiency</td>
<td>Retained placenta</td>
</tr>
<tr>
<td>Copper deficiency</td>
<td>Depressed reproduction, impaired immune system, impaired ovarian function</td>
</tr>
<tr>
<td>Zinc deficiency</td>
<td>Reduced spermatogenesis</td>
</tr>
</tbody>
</table>
Synchronization and genetics
By
Dr. Derar Refaat Ibrahim

- Pathway of PGF2 alpha in both bovine (local) and equine (systemic)

Effect of synthetic prostaglandin on mare for induction of estrus

**Estrous synchronization: Why**
1. Group females for parturition
   a. Labor, Calving period
   b. More uniform weaning weights.
2. Reduce time required for estrus detection.
3. Eliminate estrus detection with timed insemination:
   - **Prostaglandins: PGF2**
   - **Lutalyse** - Natural compound 25 mg dose (5 ml) I.M.
   - **Estrumate** - Analogue 500 ug dose (2 ml) I.M.
   - **Prosolvin** - Analogue 15 mg dose (2 ml) I.M.
   - **Iliren** - Analogue 5 ml (each ml contain 0.15 mg) I.m.

**Principle** - Regress active corpus luteum i.e., Day 6-17 corpus luteum.
Estrus occurred 2-5 (72 hours) days after injection. 60-65% of herd should respond to injection.

To get whole herd synchronized, give 2nd injection 11 days after 1st. Cows responding to 1st injection have day 6-9 corpora lutea.
Unresponding cows now have day 6-17 corpora lutea.
**Reasons for variation of response.**
Young and old corpora lutea may respond different
Heifers react sooner than cows.

Animal may be pregnant - Abortion
Females do not have a corpora luteum, i.e. are anestrus

**Use of progestagens for Estrus synchronization**

**Principle:**
Maintain the cow under the influence of progesterone until corpus luteum regresses, remove progesterone - animal respond to progesterone with estrus. 2-5 days later.

**Administration:**
- Injection
- Feed (MAP 180 mg, CAP 10mg and MGA 1 mg/day). 3-4 days later estrus is evident.
- Implant (Norgestomet)
- Pessary or Control Internal Drug Release (CIDR) like PRID + PGF2 alpha

**Synchromate B system:**
- Inject 5 mg estradiol valerate & 3 mg norgestomet
- Implant Norgestomet (Progestagen) 6 mg under the ear (sialistic tube)
- Remove implant 9 days later.
- Breed 48 to 60 hours later or 54 hours later.

- Estradiol - Luteolytic to d 3-9 corpora lutea.
- Norgestomet - Inhibits follicular maturation.
Sex determination

[Diagram showing the process of sex determination involving GnRH, PGF, and time markers for days 0, 7, and 9, with an additional step for 24 hours later resulting in blind mating.]
Abnormalities of sex determination

Non disjunction (Turner, Klinefelter)
Chromosomal lag (chromosome out of cell)
Chromosomal deletion
Mosaicism (60 XX/60XY bull)
Chimerism (Free martin heifer)
Translocation (hermaphroditism)
duplication

Deletion

Mosaicism
Freemartin Heifers

Sterile heifers that are born twin with a bull
85% of twin births with both sex
Fetal circulations fuse, male hormone circulates into female, interferes with normal sex development
Can examine vagina of heifer to determine if freemartin (1/3 as long)

Translocation

Before translocation

After translocation

Chromosome 4

Chromosome 20

Derivative Chromosome 4

Derivative Chromosome 20
**Preselection of sex**

**PH**
- Ultracentrifugation (Y bearing chromosomes are heavier)
- Electric affinity (X chromosome is attracted to + electrode)
- Timing of insemination
- Staining (Quinacrine)

**Sex Ratio**
- Primary
- Secondary
- Tertiary
Repeat breeding

By

Dr. Derar Refaat Ibrahim

can be a major factor involved in infertility. A “repeat breeder” is generally defined as any cow that has not conceived after three services or A repeat breeder is defined as:

- a cow that has calved before,
- is less than 10 years old,
- has normal heat cycles,
- has no palpable abnormalities,
- has been bred 3 or more times and is not pregnant.

Causes

- Ovulation failure
- Chromosomal/Genetic (uterine anomalies)
- Fertilization failure (human factors, bull infertility, lethal factors)
- Release of PGF from inflammatory conditions such as mastitis
- Environmental effects (heat stress and humidity) corticosteroids are higher
- Infectious agents (BVD, IBR, Mycoplasma and Chlamydia)
Pathologic causes:
White heifer disease, Salpingiitis, Metritis and cervicitis
Nutritional
  • Vit A
  • Vit D
  • Vit E

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Bovine corpora lutea and their cysts

Congenital anomalies may interfere with fertilization

Fertilization failure
Ultrasonography of endometritis in she-camel
Notice fetal remnants (C)

Endometritis in mare

Metritis
Involving the whole layers of the uterus
Size
Thickness
Pyometra in bovine

- Not sick
- Not cycling (persistent CL)
- Closed Cervix
- Purulent exudate accumulation
Trichomonosis!
Treat with PGF2a

Trichomonas fetus
IBR lesions

Cervicitis may lead to repeat breeder
Treatment

1- Avoid the cause.
2- Hormonal treatment

GnRH \[\rightarrow\] GnRH

<table>
<thead>
<tr>
<th>Day 0</th>
<th>Day 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>(To induce ovulation)</td>
<td>post mating</td>
</tr>
<tr>
<td>(Support CL function)</td>
<td></td>
</tr>
</tbody>
</table>

2- Treatment of the acquired genital infections

Controversy exists over the effects of metritis and endometritis on fertility in cattle. Responses of individual animals to intrauterine treatment are quite variable. Some respond well to medication and conceive while others do not. Other factors such as nutrition, hormonal imbalances and overall health of the animal must be considered.

Success in treatment of uterine infections depends on:

1. Evacuation of the uterus.
2. Susceptibility of the infectious agent to the drug used.
3. Concentration and number of times the drug is used.
4. Exposure of entire endometrium, cervix, and vagina to the drug.

2- Non traditional treatments (Plasma, immunomodulators and plant extract)
3- Leave the animal to cycle normally without interference
**Preventive measures**
* Adequate housing,
** nutritionally balanced and palatable rations for the dry and fresh cows,
*** satisfactory calving facilities with optimal ventilation and sanitary conditions,
**** and avoidance of undue stress such as overcrowding and disease are absolute requirements for healthy fresh cows.
***** use of A. I. Of known non infected superior sire.

---

Figure 1: The reproductive tract of a cow
Ultrasonography in cattle and buffaloes

By

Dr. Taymour M. EL-Sherry

Anatomy of the female genital system

The Normal Ovarian structure

- Ovarian follicle
- Corpus luteum
- CH
- Ovulatory follicle
- CL of pregnancy
Small follicle

Medim size follicle

Large dominant follicle
Ovarian follicle

Rupture of ovulatory follicle

Ovarian follicle

After rupture of the ovulatory follicle

CL

Cut section in the
CL of pregnancy

It appears as a light grey echogenic structures two to four days after ovulation. It is sometimes hard to discern in the ovarian stroma even when a 8 mHz trans-vaginal scanner is used, as it has the same echogenicity of the ovarian stroma.
Follicular Dynamics

Rupture of ovulatory follicle

Ovulatory follicle

After rupture of the ovulatory follicle

CL

Cut section in the CL
It appears as a light grey echogenic structures two to four days after ovulation. It is sometimes hard to discern in the ovarian stroma even when a 8 mHz trans-vaginal scanner is used, as it has the same echogenicity of the ovarian stroma.
Follicular wave during conception

Animal no 2 cycle no 3 during conception

Diameter of follicle with mm

day of estrous

Static phase
Growing phase
Regression phase

Static phase
Growing phase
Regression phase

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After rupture of follicles
Luteal cyst
Ovary with follicle luteal cyst:
- The luteinized wall is 3-4 mm in thick. Note the network of echoes within the cavity of the cyst.

Uterus
- Uterus during normal estrous cycle
- Pregnant uterus.
Echographic image of a non-pregnant uterus.
UB= uterine body
UH=Uterine horn.
The non pregnant uterus is easily to visualized on the screen.
The shape of the coiled uterine horns can be recognized and no apparent lumen is present.
Ultrasonography
Applications in Reproductive Biology

Wael MB Noseir
Assistant professor of Theriogenology
Faculty of Veterinary Medicine, Alexandria University

History Of Ultrasound

• The development of ultrasound applications in medicine start with the history of measuring distance under water using sound waves.
• The term SONAR refers to Sound Navigation and Ranging.
• Underwater sonar detection systems were developed for the purpose of underwater navigation by submarines in World war I and in particular after the Titanic sank in 1912.

History Of Ultrasound

• The use of Ultrasonic in the field of medicine had started initially with it's applications in therapy rather than diagnosis. The destructive ability of high intensity ultrasound had been recognized in the 1920s.
• In the early 1940s ultrasound was used experimentally as a possible diagnostic tool in medicine.
• In 1953 the use of ultrasound in the treatment of patients with rheumatic arthritis was reported In USA.
Ultrasound: machine

A basic ultrasound machine has the following parts:

1. **transducer probe** - probe that sends and receives the sound waves.
2. **central processing unit (CPU)** – computer.
3. **transducer pulse controls** - changes the amplitude, frequency and duration of the pulses.
4. **display** - displays the image from the ultrasound data processed by the CPU
5. **keyboard/cursor** - inputs data and takes measurements from the display
6. **disk storage device** (hard, floppy, CD).
7. **printer** - prints the image from the displayed data.

Ultrasound: transducer

- The transducer probe is the main part of the ultrasound machine. The transducer probe makes the sound waves and receives the echoes (*It speaks, the mouth and ears of the ultrasound machine*).
- The transducer probe generates and receives sound waves using a principle called the piezoelectric (pressure electricity) effect (*piezoelectric crystals*).
- When an electric current is applied to these crystals, they change shape rapidly (vibrates) and produce sound waves that travel outward.
- Conversely, when sound or pressure waves hit the crystals, they emit electrical currents.
Types of Ultrasound: transducers
There are two types of ultrasound transducers;
• **Linear array transducer:**
  Crystals are arranged in a line along the surface of the transducer, and are activated sequentially to produce a rectangular sound beam.
• **Sector transducer:**
  Mechanical sector transducers contain a single oscillating crystal or a small number of crystals mounted on a rotating wheel.
• In general, sector transducer is the preferred transducer type for small animals and linear for large animals.

Types of Ultrasound: transducers
• Depth of tissue penetration of sound waves and image resolution is dependent upon and inversely related to the frequency of the transducer.
• Low frequencies (2-3.5 MHz) of sound will penetrate well into soft tissue but will not produce image resolution of highest quality.
• High frequencies (7.5-10 MHz) produce optimal image resolution but are limited in tissue penetration. These transducers are selected for superficial structures where image detail is of paramount importance.

Types of Ultrasound: probes
There are three types of ultrasound probes;
• Transrectal probes
• Transabdominal probes
• Transvaginal probes
Types of Ultrasound: display

- The echo image on the screen will appear in varying shades of gray (black to white, 0-255).
- The shade of gray is determined by the density of the tissue encountered by the sound waves and subsequently the amount of sound waves reflected back to the transducer.
- Tissue or structures can be classified as either echogenic or non-echogenic in their capacity to reflect sound waves.

Types of Ultrasound: display

- Echogenic structures reflect some or most of the sound waves, depending on their density. The denser the tissue, the more sound waves are reflected and the more white the image (*hyperechoic-hypoechoic*) will appear on the screen (bone-soft tissues).
- Fluids do not reflect sound waves and hence are non-echogenic, (embryonic vesicles, ovarian follicles) and will appear as black areas on the ultrasound screen.

Types of Ultrasound: display

- A-mode
- B-mode
- M-mode
- 2D-real time
- Pulsed-wave Doppler
- Continuous-wave Doppler
- Color Doppler
- Power Doppler
- Duplex

Applications of Ultrasound Technology

Veterinary Reproductive Management

Applications of Ultrasound Technology
Applications of Ultrasound: ovaries

Imaging of ovarian structures:
- Ovarian Follicles
  - Follicular waves

Applications of Ultrasound: ovaries

Imaging of ovarian structures:
- Corpus luteum

Applications of Ultrasound: ovaries

Imaging of ovarian structures:
- Ovarian Cysts
Applications of Ultrasound: uterus

- Abnormal fluids, which may be a sign of pyometra.
- Pregnancy diagnosis by the detection of anatomical structures of the conceptus:
  - Amniotic cavity in early embryonic development (Fluid-filled amnion appears black and the amnion membrane is bright white).
  - Fetus.

Applications of Ultrasound: uterus

- Identification of twins.
- Detection of early embryonic loss.
- Monitoring breeding programs and A.I. techniques.

Applications of Ultrasound: uterus

- *The earliest that pregnancy can be detected with 95 to 100% accuracy:*
  - Horses - day 15 of gestation (transrectal).
  - Cattle - day 25 of gestation (transrectal).
  - Sheep - day 30 of gestation (transrectal), and day 45 - 50 of gestation (transabdominal).
Applications of Ultrasound: fetus

Fetal viability:
- Presence of the fetal heartbeat can be seen by day 25 of gestation.
- Fetal heartbeat and integrity of the conceptus can be evaluated during the first 60 days.

Applications of Ultrasound: fetus

Fetal aging:
- Done between days 25 to 60 of gestation by measuring the size of the fetus.

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

Applications of Ultrasound: fetus

Fetal number:
- Typically done to determine nutritional strategies and parturition problems in animals carrying single vs. multiple fuses during gestation.
Applications of Ultrasound: fetus
Fetal sexing:

- Done between days 55 and 70 of gestation in cattle by identifying the swollen fetal genital structures (genital tubercle).
- Male - scrotal swelling, fetal prepuce against umbilicus.
- Female - lack of male structures and appearance of a vulva under the tail.

Applications of Ultrasound: fetus
Fetal sexing:
- Male - swollen genital tubercle, near umbilical cord.
- Female - lack of swollen genital tubercle, near the tail.

Applications of Ultrasound: male
Testes:
- Monitoring of normal and diseased conditions.
Recent Advances in Ultrasound Technology

Color Doppler

4D-ultrasound

OPU
- Transvaginal ovum pick-up (OPU)
- Ultrasound-guided transvaginal aspiration of ovum.
Echotexture

- Evaluation of changes in echotexture components of ultrasound images (MPV & PH).

Management of Twin Pregnancy

- Attempts to reduce twin pregnancies detected during the fetal stage of pregnancy.
- These methods include; transvaginal ultrasound guided puncture of the conceptus, and transabdominal ultrasound guided injection of the fetus.

Fetal mummy present as an invaginated sac in the allantoic cavity of the remaining normal placenta at term (arrow)