

Congenital fetal defects (Teratology)

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Hybrids

- Hybrids are crosses between closely related species are often inviable or, if they live, they are sterile.
- The water buffalo has two subspecies or types: the river and the swamp buffalo which differ in their chromosome number ($2n=50$ in river type and $2n=48$ in swamp type). Crosses between these two species are possible and also the hybrids ($2n=49$) are fertile.
- The reason of this is due to a conservation of chromosome arms (and gene pool) between the two species. Indeed, the large swamp buffalo chromosome 1 originated by tandem fusion translocation between river buffalo chromosomes 5p and 9.

Equine hybrids

- A mule is the cross between female horse and male donkey.
- A hinny is the cross of male horse and female donkey, mule and hinny is a reciprocal hybrid.
- Zebroid
- A zebra and a donkey creates zeedonk or zonkey
- Zebra and a horse creates a zorse
- Zebra and a pony creates a zony or a zetland
- Donkey and a Zebra creates a Zebret or a Donkra
- Horse and a zebra is a **Hebra**

- **Fertility of equid hybrids**
- Male mules (johns) are sterile, but fertile female mules (mollies) sometimes occur. The different number and different structure in chromosomes makes it difficult for them to pair up. Donkeys have 62 chromosomes, horses have 64 so their hybrids (mules and hinnies) have 63. Zebras have between 32 and 46 (depending on species) and their hybrids are sterile and infertile.
- It is harder to cross species if the female has less chromosomes than the males, as in the crossing of a stallion and a jenny (female donkey), this results in minimal breeding of hinnies.

- **Why are mules preferred?**

- Mules are preferred because they are more tolerant to heat than horses. Horses are more efficient in cold weather and mules, like donkeys, are more effective in deserts. Horses are more likely to suffer from exhaustion when compared to mules. Since mules are relatively slower than horses they are much safer to ride than horses. It is cheaper to rear a mule than a horse because they consume less. Lastly, mules are more enduring than a horse and can live longer.

- Bovid hybrids

- Dzo, zo or yakow; a cross between a domestic cow/bull and a yak.
- Beefalo, a cross of an American bison and a domestic cow. This is a fertile breed; this, along with mitochondrial DNA evidence, has led bison to occasionally be classified in the genus *Bos*.
- Zubron, a hybrid between wisent (European bison) and domestic cow.
- Yakalo, a hybrid between a bison and a yak.

Sheep x Goat hybrids

- Sheep (CN=54) x Goat (CN=60) is called Geep or shoat
- Very rare
- Artificially created sheep x goat chimera are produced by combining embryos of the 2 species.
- Reports of sheep x goat hybrids in nature have appeared from Botswana, USA and New Zealand with hybrids having 57 chromosomes although naturalists question them.
- Hybrid male mammals are often sterile due to Haldane's phenomenon
- Haldane's rule says that the interactions between an X chromosome from one species and a Y chromosome from the other species lead to hybrid incompatibility in males

- **Teratology:** embryology + pathology
- **Cytogenetics:** genetics of cellular constituents related with heredity
- **Karyotype:** Systematized arrangement of chromosomes in pairs
- **Autosomes:** Paired chromosomes in mammalian somatic cells
- **Sex Chromosomes:** Chromosomes in gamete producing organs. Mammalian females have paired (XX homogametic) and males have unpaired (XY heterogametic) chromosomes whereas, in birds female is heterogametic (ZW) and the male is homogametic (ZZ).
- **Parthenogenesis:** Ovum activated by means other than the sperm.

- **Agynogenesis:** Ovum activated by the sperm which do not take part in fertilization
- **Androgenesis:** Ovum activated by the sperm but the ovum do not take part in fertilization.
- **Wandering of the ovum:** Trans-uterine migration of the ovum
- **Superfecundation:** Female in estrus release many ova which are fertilized by sperms from different males
- **Superfetation:** Pregnant female comes in estrus and conceives.
- **Telegony:** Misbelief among dog owners that a bitch once conceived by a mongrel dog her subsequent pups would have the mongrel characters.
- **Chromosomal aberrations:** Abnormalities in the number and structure of the chromosomes
- **Normal Karyotype:** Cow 60, swamp buffalo 48, River buffalo 50, sheep 54, goat 60, horse 64, donkey 62, pig 38, cat 38, dog 78.

- Numerical aberrations:
- **Aneuploidy:** Chromosome number is diploid but one is in excess or in deficiency $2n \pm 1$, $2n \pm 2$
- X chromosome aneuploidy (XO turners syndrome, XXX triple X syndrome)
- XXY (Kleinfelters syndrome)
- **Trisomy** ($2n + 1$), monosomy ($2n - 1$), nullisomy ($2n - 2$)
- **Polyploidy:** Whole set of chromosomes increased ($3n$, $4n$ or $5n$) because of failure in reduction of number, polyspermy or polygyny (Polar body taking part in fertilization)

Congenital fetal defects

Are abnormalities of structure or function present at birth. They may affect a single anatomic structure or function, an entire system, parts of several systems or both a structure and a function.

Minor (Anamoly)

Defects may be visible → < Major (Monster)

The defects may be lethal, semi-lethal or non-lethal

Defects are either inherited or arise because of the environment

- **Mosaic**: Animal with 2 or more cell populations derived from a single zygote which differ in chromosome number and/or structure
- Mosaicism may result from:
- Unusual events in cell division (mitosis).
- A gene mutation during development
- A chromosomal mutation during development
- X-inactivation: one X chromosome is randomly switched off in cells of a female mammal
- Viral infection that can range from small mutations to changing large pieces of DNA

- Mosaicism had been understood since the 1880s to be generally related to genes. But a specific genetic mechanism that causes mosaics was uncovered by Curt Stern in 1936, when he demonstrated that recombination, which is a normal part of meiosis, can also take place in mitosis. When it does, it results in somatic (body) mosaics. These are organisms which contain two or more genetically distinct types of tissue.

- **Chimera**: An animal or its tissues having 2 or more cell populations derived from two or more zygotes.

Types of chimeras

- **Dispermic**
- When two fertilized eggs happen to fuse, this results in one organism with two genetically distinct cell populations. The resulting "dispermic chimera" has distinct DNA in different tissues, for example, a liver arising from one cell population and kidneys arising from the other. In animals, an easily observable examples of chimerism is a patchwork coloration of skin, hair, fur, and even the iris of the eyes.

Other causes of two-tone appearances

When eye colors vary between the two eyes, or within one or both eyes, the condition is called heterochromia iridis (= 'different coloured iris'). Apart from mosaicism, it can have non-genetic causes. For example, David Bowie had the appearance of different eye colors due to an injury that caused one pupil to be permanently dilated.



Structural aberrations (Due to segmental break with reunion) include deletion, duplication, Inversion or translocation. And result into early embryonic deaths or monsters.

- **Inherited or genetic fetal anomalies**



- **Achondroplasia:** (Bull dog Calf) Common in Hereford, Ayrshire, Dexter and Angus cows compressed skull, short upper jaw. Heavily muscled small calf

- **Epitheliogenesis imperfecta:** Skin fails to form commonly on legs, knees and muzzle.

- **Hypotrichosis:** Partial to complete loss of hair



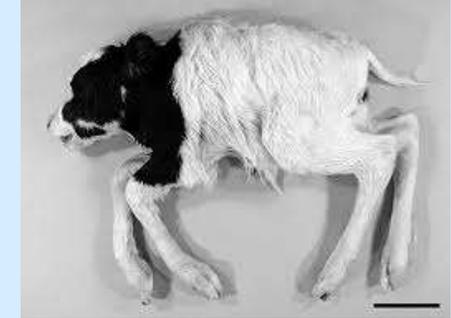
- **Icthyosis congenita:** Lack of hair, thick scaly skin

- **Arthrogryposis:** Joints of all 4 legs are fixed and cleft palate is present



- **Brachygnathism**(Parrot mouth)

- **Brachyspina syndrome** (Holsteins) growth retarded, short vertebral column and limbs, multiple defects in internal organs



- **Atresia ani** Failure of anal opening

- **Cerebral hernia:** (Caltin mark) frontal and parietal bone opening



- **Cryptorchid:** Abdominal retention of testes

- **Dwarfism** Many breeds snorter and compressed dwarfism

- **Fawn calf syndrome** heritable defect of Angus cows, muscle contracture and angulation of stifle
- **Water head (hydrocephalus)** Accumulation of fluid in the meninges of the brain
- **Double muscling** seen in beef breeds Herefords, Angus, Charolais
- **Inherited congenital myoclonus** : involuntary twitching of muscles

- **Perosomus elumbis** : congenital curvature of the spine, short ankylosed limbs
- **Pulmonary hypoplasia with anasarca**: Large anasarca calves seen in Maine-Anjou and Shorthorn cows.
- **Protoporphyrin**: photosensitivity
- **Polydactyly**: (Extra toes) One or all legs may have extra toes
- **Agnathia** Absence of lower jaw seen in Jersey cows

- **Dermoid cysts** : Hair like growths in the eye
- **Epilepsy**: Loss of consciousness and convulsions
- **Umbilical hernia** seen in many breeds of cows
- **Syndactyly** Mule foot in cows both parts of the hoof fused
- **Weaver calf** progressive bovine myelo-encephalopathy. Calves develop a weaving gait at 6-8 months of age
- **White eyes** : Hair coat is bleached and iris is pale blue
- **Tibial hemimelia** short or absent tibia, abdominal hernia, meningocoel common in Galloway cows.
- **Prolonged gestation** seen in many breeds



Figure 1. Dwarfism. Notice short, blocky appearance with deformed nose causing labored breathing (snorter dwarf).



Figure 4. Hairlessness (hypotrichosis) in a calf.



Figure 5. Rigid joints (arthrogryposis) in a calf. Notice rigid front legs. These calves have a cleft palate.



Figure 6. Extra toes (polydactyly).



Figure 7. Mulefoot (syndactyly). Notice single toe as compared to the normal front foot.



Figure 8. Weaver calf (progressive bovine myeloencephalopathy)/ Notice unsteady posyure of this animal.



Figure 10. Bulldog calf (achondrodysplasia).





Figure 12. Parrot mouth (*brachygnathia inferior*). Short lower jaw in a calf.

- **Non-Genetic defects**

 - **Sex anomalies :**

- **Hermaphrodite True** :gonads of both sexes

 - **Male pseudo-hermaphrodite** Testis present and external genitals of female

 - **Female pseudo-hermaphrodite** Gonadal ducts female and external genitals virilized

- **Freemartin** A infertile female calf born cotwin to a male with which it has exchanged blood during pregnancy it has ovotestis and cul-de-sac vagina

- **Mammalian hybrids**

- **Equine Mule** : Male donkey + female horse

 - **Hinny** : Stallion + female donkey

 - **Zebrokey** zebra + donkey

- **Anamolies of Head and CNS**

- **Microcephalus** : small cranial cavity and brain

- **Cyclopia(cebocephalus)** Single orbit, small skull. Feeding of veratrum→
• to sheep can cause cyclopia.



- **Hydrocephalus** fluid accumulated in the meninges of the brain

- **Crania bifida** : defect of skull

- **Anury** Tail-lessness



- **Anamolies of the trunk**

- **Schistosoma reflexus**: congenital curvature of spine,

- abdominal viscera exposed

- **Campylorrhachis scoliosa** : Lateral curvature of vertebrae

- and deformed limbs



- **Anamolies of the limbs**

- **Amelia(Otter calf)** Misssing or amputated extremities

- **Micromelia** Absence of distal half of limbs

- **Ectrodactyly** Absence of phalanges of the digits

- **Accessory limbs** Extra limbs attached to the neck, body

- **Twins** :-Symmetrical → Monozygotic (Identical) or dizygotic (Fraternal)
Asymmetrical → Normal

- **Monster Hemicardius** Imperfect parts identifiable

- Holocardius acephalus** Cranial part missing

- Holocardius amorphous** General body form
not recognizable





Common fetal monsters: 1) Perosomus elumbis 2) and 4) Amorphous globosus 3) Schistosoma reflexus

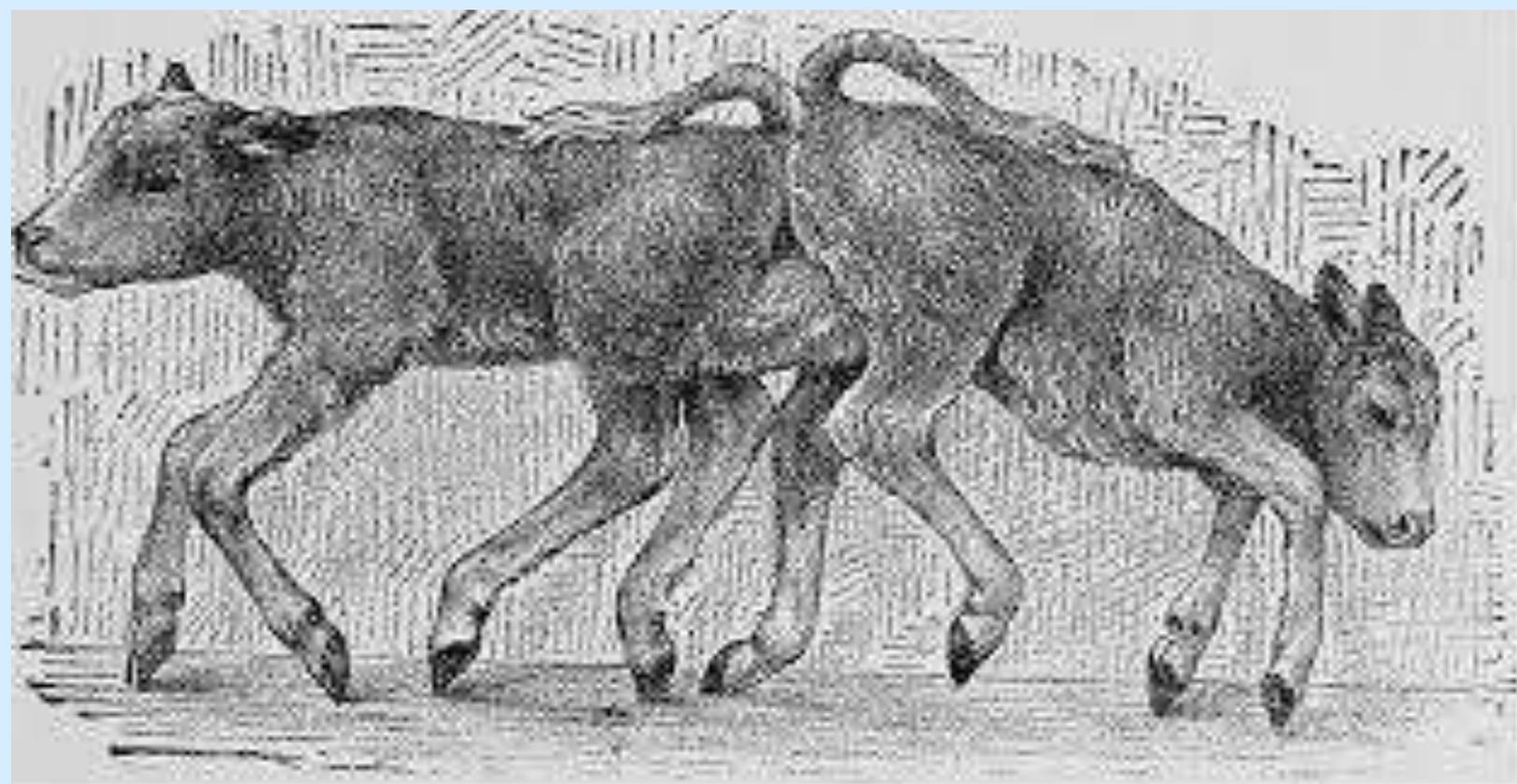
- **Conjoined twins (somatodidymi, Siamese twins)** generally monozygotic with incomplete to complete duplication
- **Thoracopagus** Twins joined at sternum face to face
- **Pygopagus** Twins joined at sacrum Back to back
- **Ischiopagus** fetuses joined at pelvis heads in opposite direction
- **Craniopagus** Twins united at heads
- **Diprosopus** double face →



- **Dicephalus** two heads and neck
- **Dibrachius** 2 pairs of fore limbs **Tibrachius** 3 pairs of fore limbs
- **Dipus** 2 pairs of hind limbs **Tripus** 3 pairs of hind limbs
- **Syncephalus** 1 face, 4 ears and a single cerebrum
- **Janiceps** **Conjoined twins with 2 faces**
 - on opposite sides

Conjoined twin monstrosities in a calf and piglet, Dipygus in a calf







Diccephalus dipus buffalo



Diplopagus buffalo



Thank You

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