TRANSLOCATION AND GENE ARRANGEMENT IN DISEASE STATES OF ANIMALS.

GENETIC DEFECTS

Genetic defects are caused by abnormalities in genes or chromosomes. There are three main types of gene diseases including gene mutation, chromosomal mutations and multifactorial problems.

Gene mutations refer to changes in gene structure as a result of change in the sequence of nucleotides of the DNA molecule in a particular region of the chromosome (alterations in DNA sequences), which is transferred to the mRNA (during transcription) and results in amino acid or protein alteration (during translation) and is subsequently seen as spontaneous changes in the phenotype as against that which as originally genotypically typed. These changes include deletion, inversions, substitution and insertion.

Mutations can also occur at the level of the chromosomes, and maybe structural or numerical. Structural chromosome aberrations include translocations, inversion, deletion, transpositions and duplication. Types of changes in the number of chromosomes in a cell maybe grouped as aneuploidy, polyploidy and abnormal euploidy. Chromosomal defects usually have more profound effects on the phenotype than gene mutation and these changes occur during meiosis.

Mutations can be caused by copying errors in the genetic material during cell division, by exposure to ultraviolet or ionizing radiation, chemical mutagens, or viruses, or can be induced by the organism itself, by cellular processes such as hypermutation. In multicellular organisms with reproductive cells, mutations can be subdivided into germ line mutations, which can be passed on to progeny through the reproductive cells (during meiosis), and somatic mutations, which involve cells outside the reproductive group and which are not usually transmitted to offspring (during mitotic division).

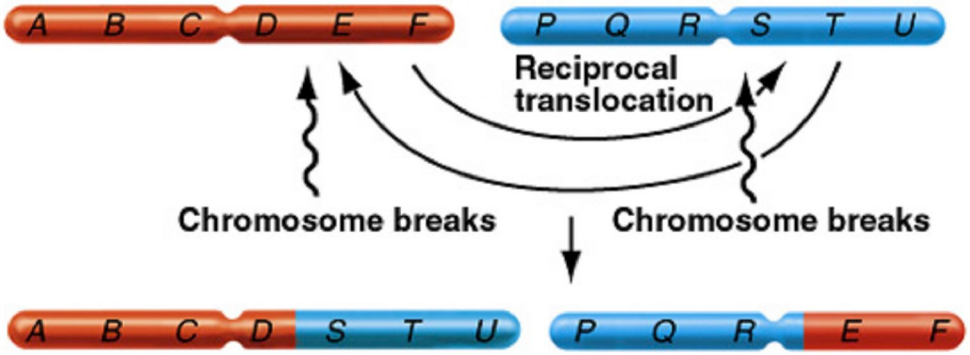
CHROMOSOMAL MUTATIONS

TRANSLOCATION

This occurs when a segment breaks off and rejoins of another end of the chromosome (reciprocal or balanced translocation) or another chromosome entirely (a non-homologous pairs; non-

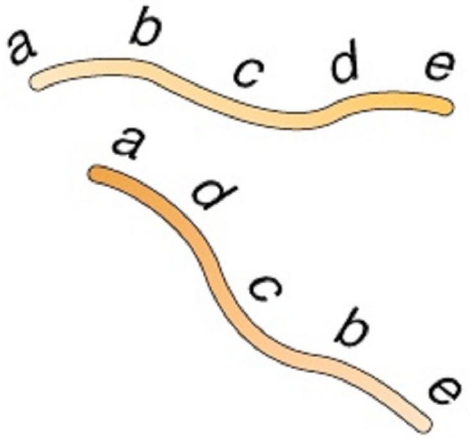
reciprocal or unbalanced translocation). Where there is translocation between non-homologous pairs, new pairs of homologous chromosomes can be produced (lead to duplications and deletions in progeny).

Translocations can often alter or abolish expression of the gene and gene products and maybe lethal. There are usually no consequences of translocation in homozygotes; genetic material is neither lost nor gained but in heterozygotes with non-reciprocal translocation genetically imbalanced gametes result with deletions or duplications; zygotes produced by these gametes are not viable.



INVERSIONS

This occurs when the order of a particular gene is reversed and result from insertion of a chromosome fragment in reverse orientation after breaking off the parent chromosome, there are usually no phenotypic consequences. However it can sometimes lead to a mutant phenotype i.e. the sequence may not be viable to produce an organism depending on which genes are affected. Advantageous characteristics from these mutations are also possible.



DELETIONS

Deletion (loss of segment); In these conditions genes of a chromosome are permanently lost as they become unattached to the centromere and are lost forever, hence the new chromosome after meiotic division, lacks certain genes which may prove fatal depending on how important these genes are.

Deletions maybe intragenic deletion; where small deletion within gene occurs and inactivates gene and has the same effect as a other null mutations of that gene, or multigene deletion in which case many genes are deleted, often with severe consequences such as gene imbalance.

Pseudodominance is a phenomenon that can also result from deletion where it seems as if the recessive alleles are showing dominance because the dominants have been deleted and possible expression of deleterious recessive mutation.

TRANSPOSITION

This refers to movement of DNA elements or segment from one site in the genome to another. Certain mobile genetic elements exists and can be found in all organisms, they have no known functions and are also known as transposons (transposable elements). There are two main classes of transposons- retrotransposons (related to retroviruses) and DNA-only transposons.

DUPLICATION

This is the gain of a segment. It is usually a source of new genes and gene families.

It can result into tandem duplication where segment is attached adjacent to its duplicate (adjacent duplications) in same or reverse order or non-tandem/ insertional duplication, here duplicate gene inserted elsewhere in the genome (same or reverse order). It may be a consequence of unequal crossing-over.

Most duplications have no phenotypic consequence but sometimes the effects can be seen due to increased gene dosage. Duplication plays a very important role in evolution through increase gene number and evolution of new genes (paralogs).

The mutant genes are displayed twice and the duplicate is usually harmless.