Prevention and early diagnosis of birth defects

Birth defects are deviations from the normal prenatal development of a human individual. They can be divided into structural or functional. Currently, we know hundreds to thousands of different types of diseases and defects that can be diagnosed after birth or in the first months of life. In the Czech Republic, the incidence of birth defects in live births is currently around 3-5%[1]. It is primarily a cell damage that manifests itself in tissues and organs. Congenital defects can be multiple or isolated. *Structural defects* are related to a certain part of the body (cleft palate or lip, heart defects, limb abnormalities, neural tube defects - eg spina bifida, CNS developmental disorders). "Functional disorders" can affect many organ systems and often have different phenotypic manifestations:

Nervous system
: Typical structural defects affecting the CNS include neural tube closure disorders (spina bifida, anencephaly). Complex (syndromic) developmental defects affecting the CNS include: *Down's syndrome, Prader-Willi syndrome, fragile X syndrome.* psychomotor retardation, behavioral disorders, autistic spectrum disorders, problems with learning, speech or expression and, last but not least, motor problems often appear.

Circulatory system
: Congenital heart defects are among the most common (up to 1/3 of all congenital heart defects). These are often disorders of valve development, insufficient separation of individual circulations (persistent communication).

Senses
: Blindness, congenital cataract, and severe hearing impairment leading to deafness. Typically in children of mothers infected with *syphilis* (up to 1/3 of newborns are deaf).

Metabolic disorders
: Among the most common are *phenylketonuria* (PKU) and *congenital hypothyroidism*.

Causes of Birth Defects

Most often, congenital defects are caused by a combination of several factors - in addition to genetic predisposition, physical, biological or chemical external factors (*teratogens*) are also involved:

- monogenic defects – gene mutations - e.g. Achondroplasia, Marfan syndrome
- errors in the number or structure of chromosomes (chromosome aberrations)
- environmental teratogenic factors to which a woman is exposed during pregnancy – e.g. viral infections (rubella), drugs or alcohol

In up to 60% of VVVs, the cause of their occurrence is unknown. Around 30% is attributed to genetic factors, 10% to environmental factors.

Diagnosis of birth defects

If there is a certain suspicion of VVV in an already born child, the parents (suspect of the affected child) are recommended to be examined by a clinical geneticist. In addition to morphologically clearly recognizable defects, the reason for suspicion can be, for example, a finding on imaging methods (e.g. developmental defects of the kidneys detected on USG examination of the abdomen, various developmental anomalies of the CNS shown by e.g. MRI). Based on the phenotype and the results of various auxiliary examinations, it is possible (in some cases) to indicate a targeted genetic diagnosis (molecular genetic or cytogenetic - see below) to confirm or rule out the diagnosis (syndrome) under consideration.

- *cytogenetic examination* - examination of the number and structure of chromosomes, which is carried out in an optical microscope.
- "molecular genetic examination" - serves to diagnose changes in genetic information at the DNA level (mutations). It is carried out in a targeted manner - in case of a specific suspicion of a certain genetically determined disease.

The diagnosis of VVV during pregnancy is dealt with by prenatal diagnosis, in indicated cases (high risk of repeating a known diagnosis of a genetically determined disease) also preimplantation genetic diagnosis (as part of assisted reproduction, the genetic information of embryos is checked before their implantation).

Prenatal VVV tests

1. **Non-invasive methods**
   - biochemical – Biochemical screening of the first trimester (PAPP-A, β-hCG) or screening of the second trimester. trimester (α-fetoprotein (AFP), human chorionic gonadotropin (hCG), unconjugated estriol (uE3))
   - ultrasound (USG), possibly in indicated cases MRI of the fetus
   - non-invasive testing of the most common chromosomal aneuploidies (new method, not yet covered by health insurance in the Czech Republic)

2. **Invasive methods**:
    - amniocentesis (16-17 weeks)
    - choria biopsy (CVS) (from 11 weeks)
    - fetal blood collection – cordocentesis (from around the 20th week)

Invasive methods are used only when there is a serious suspicion of damage to the fetus. Even today, these methods carry a certain risk of miscarriage (generally 0.5 - 1%).

Prevention of birth defects

The main thing is **primary prevention** - i.e. measures that can be applied even before the appearance of the defect itself. In this regard, it is important to educate women of childbearing age regarding harmful factors in pregnancy and their prevention. A few guidelines are recommended for parents:

- "Planned parenthood" - unplanned pregnancy has a much higher risk of (unwanted) exposure to harmful factors,
- "pregnancy at a productive age" - it is proven that the incidence of numerical chromosomal abnormalities (e.g. Down's syndrome) often increases with the age of the mother,
- "restriction of contact with teratogenic substances" - applies not only to alcohol, but also to medications for mothers with chronic diseases (antiepileptics, antihypertensives, etc.),
- "good health" - especially for women suffering from a chronic disease that requires good compensation (DM, epilepsy, PKU, thyroid disease,...),
- "adequate nutrition" – a balanced representation of nutrients, vitamins and trace elements. As part of the prevention of neural tube defects, expectant mothers are recommended a higher intake of folic acid - supplementation of approx. 0.4 mg per day.

Links

Related Articles

- syphilis
- phenylketonuria
- hypothyroidism
- mutagens
- teratogens

External links

- Vrozene-vady.cz (http://www.vrozene-vady.cz/)
- Primary prevention of developmental defects (SLG ČLS JEP) (http://www.slg.cz/primarni-prevence-vrozenych-vyvojovych-vad)

References

- Birth Defects (https://www.medicinenet.com/birth_defects/article.htm)
- The primary prevention of birth defects (http://www.medsci.org/press/birthdefect.html)
- Prevention of Congenital Anomalies (https://www.karger.com/ProdukteDB/produkte.asp?Aktion=ShowEachType&ProduktNr=228572)
- Primary prevention of congenital developmental defects (http://www.szu.cz/uploads/documents/czzp/seminare/2010/VVV_20oct10/primarni_prevention_VVV_Dr.Sipek.pdf)
- Prenatal diagnosis of VVV (http://eamos.pf.jcu.cz/amos/kpk/externi/kpk_1408/26.pdf)

References

1. ARROW, A – GREGOR, V – HORACEK, J. , et al. [Course of congenital malformation incidences and their changes over time in children born in the Czech Republic]. *Ceska Gynekol* [online]. 2012, vol. 77, no. 5, p. 424-36, Available from <https://www.ncbi.nlm.nih.gov/pubmed/23116348>. ISSN 1210-7832.