Neural tube defects

Human birth defects, today, continues to be a highly investigated research. There remain many convoluted combination of genetic and environmental factors that can cause birth defects. While some conditions are easily repaired through surgery, neural tube defects (NTDs) present problems even after surgery. Many steps can be taken for the pregnant mother to prevent any chances of birth defects. There are two major ways of preventing NTD. First, a daily dose of folic acid is known to prevent NTD and other birth defects during pregnancy.

Second, surgical in utero, or " in the uterus", repair of NTD improves the chances of patient mortality (Finnel et. al, 2013). Despite of medical and technological advances, we know very little about how folic acid acts on NTDs. And as previously mentioned, even after surgical repair, the chances of a successful or normal birth are unknown. This research paper investigates the role of folic acid and its role in neural tube defects. We discuss recent research to find our answers.

Overview of embryology and NTDs. Neural tube defects are often developed during early embryonic development. During embryogenesis, the defects arise when the flat sheet of cells that rolls up but does not close shut to form a hollow central nervous system. There are two common conditions: NTDs that are restricted to the cranial region are referred to as anencephaly. It is characterized byfailureof the rostral (head) portion of the neural tube to close. This result in an absence of thee brain, skull, and scalp. Defects that occur along the audal, or tail end, of the neural tube are called spinal bifida. More commonly occurring than anencephaly, spinal bifida affects structures through which the minenges and the spinal cord protrude. When both the

cranial and the caudal portions fail to close, this extremely rare and lethal NTD is called craniorachischisis (Aldoori et. al, 2008; Finnel et. al, 2013). Epidemiology Annually in the United States, there are approximately 3000 pregnancies affected by spinal bifida or anencephaly. This number can easily be reduced by half by a folic acid supplement.

The highest rate occurs in Hipic populations because they have low folic acid levels in their diet. The current prevalence of NTDs as a collective is approximately 1 in every 2000 births. Although the prevalence rates vary from country to country, it is clear that there are three aspects that control the development of such conditions: genetic, environmental, and nutrition. The most common and difficult to account for are the affects ofenvironmentand nutrition on the growing embryo, specificallydiabetes, obesity, smoking, and alcohol consumption (CDC, 2011).

The biology of NTDs The complex nature and the process of neural tube closure have temporarily halted our understanding of folic acid and its interactions during NTDs. As a collection of many autonomous and region-specific cells, many researchers suggest that along with the lengthening of the neural tissues, the epidermis also provides a guiding force to help fold and close the neural tube. This fusion links two neural folds into a sheet covering the outer portion hollow neural tube.

Furthermore, the closing process of the neural tube occurs at multiple sites along the rostrocaudal axis, or head to tail axis, instead of progressing from one end to the other in a continuous motion (Finnel et. al, 2013). Another complication occurs when the cells that help close the neural tube differ

regionally along the neural tube. This causes irreversible and incurable conditions like spinal bifida and anencephaly. What we know now is collectively from amphibians and chick embryos.

These studies provide a deeper understanding of how an embryo morphs, the cells involved, and the mechanism through which the regional cells cause NTDs and other conditions (Finnel et. al, 2013). Folic acid and NTDs According to the Center for Disease Control and Prevention, it is recommended that a daily dose of 400 microgram of folic acid be prescribed to females at least one month planning for pregnancy. The question of how folic acid acts on the NTDs is still very unclear. However, the research conducted helps to clarify that some cellular activity may be involved.

Research studies using mice suggest that this may start from the biosynthesis of DNA, RNA, and other structural proteins and lipids. “ Therefore, deficits in folic acid metabolism could affect cell proliferation, cell survival, transcriptional regulation, or a host of other cellular reactions; defects in any of these processes could disrupt neural tube closure” (Finnel et. al, 2013). Mutations in mice were studied using genetics and environment. In these experiments, several mutations of mice were compared using various biomarkers.

The genetic approach sought for alterations in the pathway of mutations when there was a deficiency of folic acid. The environmental study researched the responsiveness, of genes and its environment and the external environment (predominantly nutrition), to folic acid in hopes of surfacing mechanisms through which folic acid promotes neural tube closure

(Finnel et. al, 2013). To summarize, there is a very poor understanding of how folic acid promotes neural tube closure and very little insight into distinctly clarifying the specific pathways that folic acid prevents the aforementioned NTDs, regardless of the three factors.

The continuation of research using mice (because they have a very similar neural development as humans) provides hope to find the various “ developmental processes and molecular pathways can be related in terms of folic acid responsiveness and to gain molecular insights into optimal interventions to prevent NTDs” (Finnel et. al, 2013). Nutrition and supplements As mention before, the recommended daily dose of folic acid is 400 micrograms (or 0. 4 milligrams). This can be easily achieved by eating breakfast cereals (serving sizes may vary), flour (breads and pastas), white rice, and cornmeal.

It is also strongly recommended that women who are breastfeeding or are on birth control continue to take their daily dose of folic acid unless directed by their physician (Women’sHealth, 2010). Many supplements today contain a blend of vitamins and minerals to help sustain the body and many have a 100 percent of the recommended daily dose, including folic acid. As one passes the child-bearing age, the dosage is maintained along with sufficient amount of vitamin B12 for overall good health (Women’s Health, 2010).

NTDs are most common in women who don’t have adequate amounts of folic acid, including the Hipic population and those without adequate medical aid. The mechanism through which folic acid reacts with the embryo is unclear. A deficit of folic acid, initially, results in spinal bifida and anencephaly and

could cause other defects, including stillbirths. An excess of folic acid causes nerve damage to the parent, which could potentially translate to the embryo. Although much research has already been done, the animal studies provide a bright outlook to solving this dilemma.