Wernicke's (alcoholic) encephalopathy

Reports of autistic behaviors among children exposed during gestation to alcohol and other drugs began to appear in the 1990s [1-3]. The finding of autism among children with fetal alcohol syndrome should be considered alongside the finding of autism in children exposed to rubella infection during pregnancy [4, 5]. Most important, the question should be raised as to what areas of the brain are affected both by infections and alcohol or other toxic substances, especially during gestation, and how this might lead to autism in some cases. Autism has also been found in children of mothers taking valproic acid (Depakote) during pregnancy [4, 6]. Autism has also been reported in some victims of severe deformities caused by maternal use of thalidomide during pregnancy [7].

It has been known for over a century how the brain is affected by alcohol [8]. Wernicke (1881) first reported the characteristic pattern of bilaterally symmetric hemorrhagic lesions within the brainstem caused by chronic alcohol intoxication. This pattern of selective brainstem damage now bears the name Wernicke's encephalopathy (WE) and its association with alcoholism has been confirmed many times over. This pattern of damage can be compared to the ischemic lesions caused by brief total asphyxia at birth [9]. The inferior colliculi are affected in most cases whether by alcoholism or asphyxia, but the most predictable lesions caused by alcohol abuse are in the mammillary bodies [10, 11].

Figure 14 below is from a paper by Kant (1933) and shows petechial (pinpoint-size hemorrhagic spots) in the inferior colliculi and surrounding areas of the midbrain, which are characteristic of the damage in Wernicke's encephalopathy [12]. Early papers, written in German, describe the damage in WE as small "flea-bite" size hemorrhages that result from engorgement then bursting of capillary vessels, similar to the "whiskey nose" of many alcoholics.

The mammillary bodies are among the brainstem nuclei of high metabolic rate, slightly less active than the inferior colliculi (see table 4 above). Protective mechanisms (like hemoglobin’s release of oxygen to tissues with greatest output of carbon dioxide) may spare the most metabolically active inferior colliculi but make the mammillary bodies more vulnerable to damage – just as motor areas of the cortex become more susceptible to damage by hypoxia in utero or during birth. The mammillary bodies are part of the limbic system, in which Kemper and Bauman (1998) found signs of disrupted prenatal development in brains from some autistic individuals [13].

Figure 18 (above left) shows myelin stain in a midline (or sagittal) section of the brainstem of a human fetus at 25 gestational weeks (gw) from Yakovlev and Lecours (1967); this can be compared with the transverse section in figure 18 (right) [14]. Figure 18 (left) shows the greater degree of myelination in the superior olive (SOl) and trapezoid body (TzB) of the auditory pathway compared for example with the lesser degree of myelination in the superior colliculus (SCol) of the visual system.

Figure20 is a diagram of a sagittal view showing the location of brainstem structures of high
metabolic rate that are vulnerable to damage from alcohol intoxication and other factors that impair aerobic metabolism. Structures shown in figure 20 can be compared to degrees of prenatal myelination of those in figure 18 (left). Greater detail and orientation can be found by studying diagrams (transverse, sagittal, and coronal) given in textbooks of neuroanatomy, like that of Nolte and Angevine [15].

The brainstem nuclei of high metabolic rate are susceptible to damage by any factor that disrupts aerobic metabolism. The early maturation of nuclei in the auditory pathway prevents recovery from injury. Neural plasticity is unlikely to repair or rewire connections of auditory nuclei damaged by anoxia at birth, and pathways like those needed for language development that depend upon synaptic inputs from brainstem auditory centers will fail to become normally established.

References
8. Wernicke C (1881a) Die acute, haemorrhagische Poliencephalitis superior.
Figure 19: Wernicke's encephalopathy, caused by chronic alcohol intoxication or deficiency of thiamine (vitamin B1) deficiency, is characterized by small hemorrhages in the inferior colliculi (Corpus quadrigeminum posterior) and grey tissue around the aqueduct of the midbrain. From Kant (1933).
Figure 20: Location of subcortical structures affected in Wernicke's encephalopathy