G85 Evaluation of Iron and Macrophages in Meninges of Infants Dying Suddenly and Unexpectedly

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The goals of this research project are to assess the significance of iron and macrophages in the leptomeninges and dura of infants and young children dying without evidence of head injury.

As potential pathological markers for occult head injury, the presence of iron and macrophages in the meninges of infants and young children who died of various causes and without evidence of head injury were evaluated. This preliminary study was conducted in order to develop criteria for assessing whether these markers are reliable indicators for head injury when identified microscopically in the leptomeninges and dura of infants dying suddenly and unexpectedly.

For this study the authors evaluated 18 deaths involving infants and young children ranging in age from 0 to 2 years old, with a mean age of 23 weeks. These included 4 deaths of Sudden Infant Death Syndrome (SIDS), 6 additional natural deaths, 2 unintentional deaths, 1 homicidal death, and 5 deaths due to undetermined causes. None of the cases had history or anatomic evidence of head injury. They selected 3 samples of leptomeninges from each infant and, in 12 of the 18 cases, one sample of dura. They examined tissue sections stained by hematoxylin and eosin (H&E), trichrome, an iron stain for hemosiderin, and an immunocytochemical stain for the macrophage marker, CD68. Under a 40x objective lens, they graded the microscopic features of each section semi-quantitatively for the presence and quantity of iron and macrophages. An "iron score" of 0 to 4 was ascribed to each section as follows: no staining for iron (score 0); occasional staining with most fields negative (score 1); focally abundant staining with most fields showing no staining (score 2); focally abundant staining with most fields showing positive staining (score 3); prominent staining throughout the section (score 4). Because there were 3 sections of leptomeninges examined, they calculated a "total leptomeningeal iron" score from 0 to 12 by simply adding the individual scores from each section of leptomeninges from the same case. As only one section of dura was examined, possible scores for the "total dural iron" ranged from 0 to 4. The "total macrophage" scores from both leptomeninges and dura were derived using the same procedures.

Eleven of the 18 cases showed a total leptomeningeal iron score of zero (of 12 possible); i.e., no iron was observed in any of the three sections. Four of the eighteen cases received a total iron score of 1/12; one case had a score of 2/12; one case had a score of 3/12; and one case had a score of 4/12. The dura (n=12) showed slightly higher total iron scores with only three of the 12 cases having total iron scores of 0 (0/4). Four of the cases had a score of 1/4; 3 cases had a score of 2/4; and one case each had scores of 3/4 and 4/4. All 18 cases had positive macrophage staining on all sections with individual section scores ranging from 2 to 4. The total leptomeningeal macrophage score was 8/12 on 2 of the 18 cases; 9/12 on 4 cases; 10/12 on 3 cases; 11/12 on 5 cases; and 12/12 on 4 cases. The dural macrophage score was also positive on all 12 cases, with scores ranging from 1 to 4. Three cases had a score of 1/4; 4 cases had a score of 2/4; 2 cases had a score of 3/4; and 3 case had a score of 4/4.

These data indicate that macrophages and small amounts of iron are a common finding in the leptomeninges and dura of infants and young children who have died suddenly and unexpectedly. However larger amounts of iron deposits may indicate either birth injury or occult traumatic brain injury. As a continuation of this preliminary study, we are evaluating additional cases of sudden infant deaths in order to establish a "normal" basis of iron and macrophages in the leptomeninges and dura of children with respect to age, birth history, and cause and manner of death. The ultimate outcome of these efforts is to develop objective criteria for markers of occult head injury.

Child Abuse, Traumatic Brain Injury, Meningeal Hemosiderin

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