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AGE AND GENDER-RELATED IRON DEPOSITION IN CENTRAL NERVOUS SYSTEM: DETERMINATION OF NORMAL VALUES

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Abstract

Increased iron brain deposition (BID) has been shown in many neurodegenerative diseases. The normal pattern can be determined trhough the analyses of transverse relaxation time (RT2). 207 healthy subjects BID on thalamus, substantia nigra (SN), dental nucleus (DN) and globo pallidus (GP) were determined, as the correlation with gender and age. DNs, right GP and SNs correlations were found. These data may be used for patients with Neurodegeneration with Brain Iron Accumulation disorders.

Key words: *iron deposit, neurodegeneration disease, basal ganglia.*

Introduction

The deposition of iron in the basal ganglia is an age-dependent physiological event. Increased iron has been shown in the central nervous system in many neurodegenerative diseases, such as Alzheimer's and Parkinson's disease. Thus, the determination of the normal pattern of brain iron deposition using Magnetic Resonance Imaging (MRI) through the analyses of transverse relaxation time (RT2) can be a powerful diagnostic tool. The aim of this study is to determine the behavior of RT2 in healthy subjects, with a wide age range age, establishing the normal reference values.

Results and Discussion

Methodology: T2 Multiecho images from 207 healthy subjects were used for this study. For each subject, four structures were chosen on both sides: thalamus (T), globus pallidus (GP), substantia nigra (SN) and dentate nucleus (DN). For each structure, values of RT2 were determined with the software Aftervoxel, by selecting 3 Regions of Interest (ROI – Figure 01) on 3 consecutive slices. The final RT2 value was defined as the average of the 3 ROIs. For each structure, we then performed a multiple linear regression correlating age and gender and the reference normal value was determined as the average + 2 standard deviations. For all the statistical avaliation, a value of $p < 0,05$ was considered.

Results and Discussion: From the 207 healthy subjects, 82 were male and 125 female, age range, 9-82 years. The average values of RT2 for T, DN, GP and SN were respectively: 73.26; 57.52; 50.83 and 54.33ms. We did not find correlation between the values of RT2, age and gender for Ts and left GP. However, for DNs, right GP and SNs correlations with age and gender were found and the reference values for each structure were: right T (82,105ms), left T (81,58ms), right DN (68,48ms), left DN (63,37ms), right GP (58,91ms), left GP (58,23ms), right SN (64,44ms) e left SN (65.75ms). The normal reference values are listed on the Chart 1. This data confirms information from previous studys[1,2], however, none of them have established normal values references. These data will be useful to future studies including patients with Neurodegeneration with Brain Iron Accumulation (NBIAs) disorders.

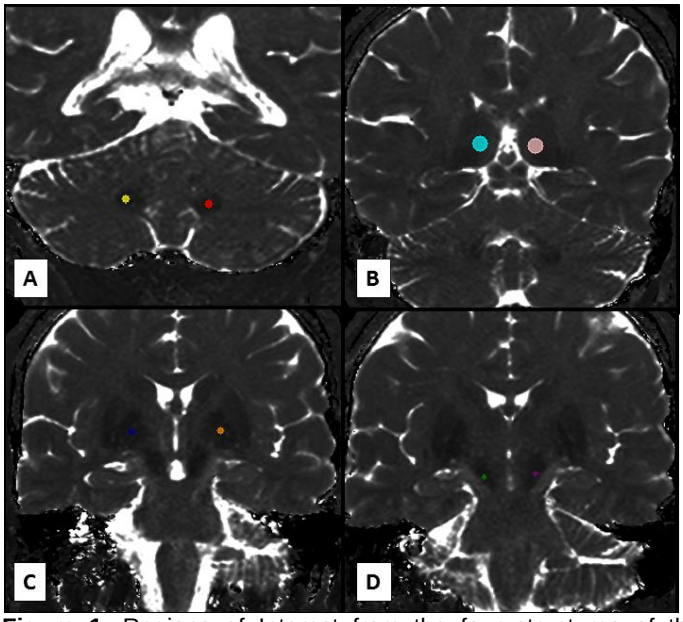

Figure 1. Regions of Interest from the four structures of the Central Nervous System from T2 images using the software Aftervoxel: (A) Right and Left ND; (B) Right and Left T; (C) Right and Left GP; (D) Right and Left SN.

Chart 1. Normal value references and the statistical significance of the age-gender relation.

Structure	Normal Reference Value (ms)	Age-relation *(p)*	Gender-relation *(p)*
Right T	64.805 – 82.105	0,978	0,324
Left T	64.161 – 81.597	0,198	0,774
Right DN	46.684 – 68.492	**<0,001**	0,06
Left DN	46.84 – 68.384	**<0,001**	**0,03**
Right GP	43.116 – 58.912	**0,006**	**0,006**
Left GP	43.083 – 58.215	0,2	0,108
Right SN	44.114 – 64.442	**<0,001**	0,216
Left SN	43.026 – 65.75	**<0,001**	0,166

Conclusions

Basal ganglia iron deposition is an age and gender-related phenomenon. The reference values obtained in this study widen the clinical usefulness of RT2 analysis in neurology, especially for patients with NBIAs disorders.

[1] Schenck JF. Magnetic Resonance Imaging of Brain Iron. *Journal of Neurological Sciences* 2003; **207**: 99-102.
[2] Zecca L, Youdim MBH, Riederer P, *et al.* Iron, Brain Ageing and Neurodegenerative Disorders. *Nature Reviews Neuroscience* 2004; **5:** 863-73.