

IN VIVO MAGNETIC RESONANCE SPECTROSCOPY AS A NON-INVASIVE TOOL FOR THE IDENTIFICATION OF A SELLAR TUMOUR IN A BOY WITH PRECOCIOUS PUBERTY.

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CASE PRESENTATION

A 4-year-old boy was admitted due to repeated episodes of focal seizures with fixed gaze, head turn to the right, and postictal drowsiness. Parents reported episodes of inappropriate laughter ("gelastic seizures") in the previous year. The child was referred to the endocrine department for investigation of possible precocious puberty.

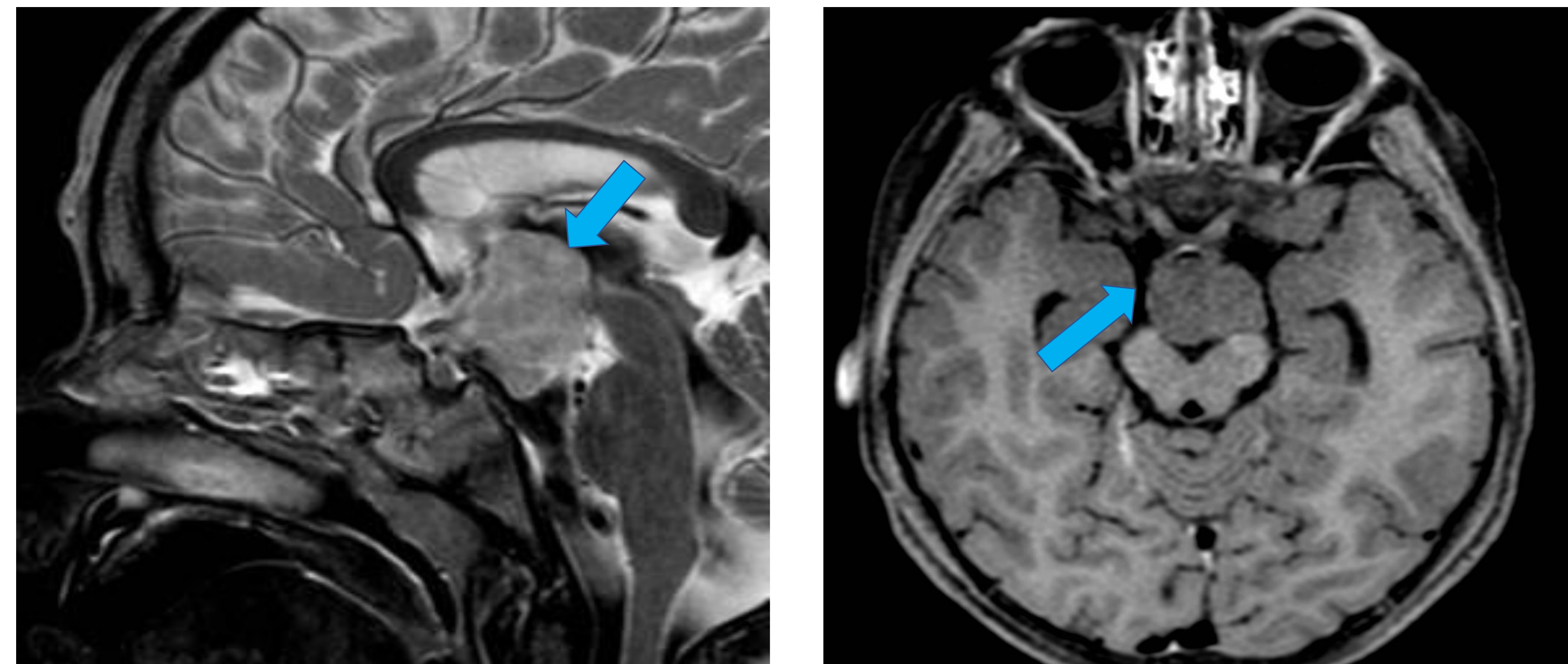
Clinical examination H: 109.8 (50th), W: 24.4 (>90th), Tanner stages: PH:I, AH:I, G II (test. volume 4-5 ml, penile length: 7.5 cm) testicular volume 4-5 ml bilaterally, penile length of 7.5 cm and absence of axillary or pubic hair.

Personal & Family History: Unremarkable

Laboratory work-up: FSH: 2.2 mIU/ml, LH: 1.65 mIU/ml, testo: 1.65 ng/ml, CEA: 2.2 ng/ml, β hCG <0.1 mU/ml, aFP: 1.7 ng/ml, 17-OH-PG: 0.38 ng/ml, DHEAS: 0.095 ng/ml, TSH: 3.74 μ U/ml, fT4: 0.96 ng/dl, F:10.39 μ g/dl

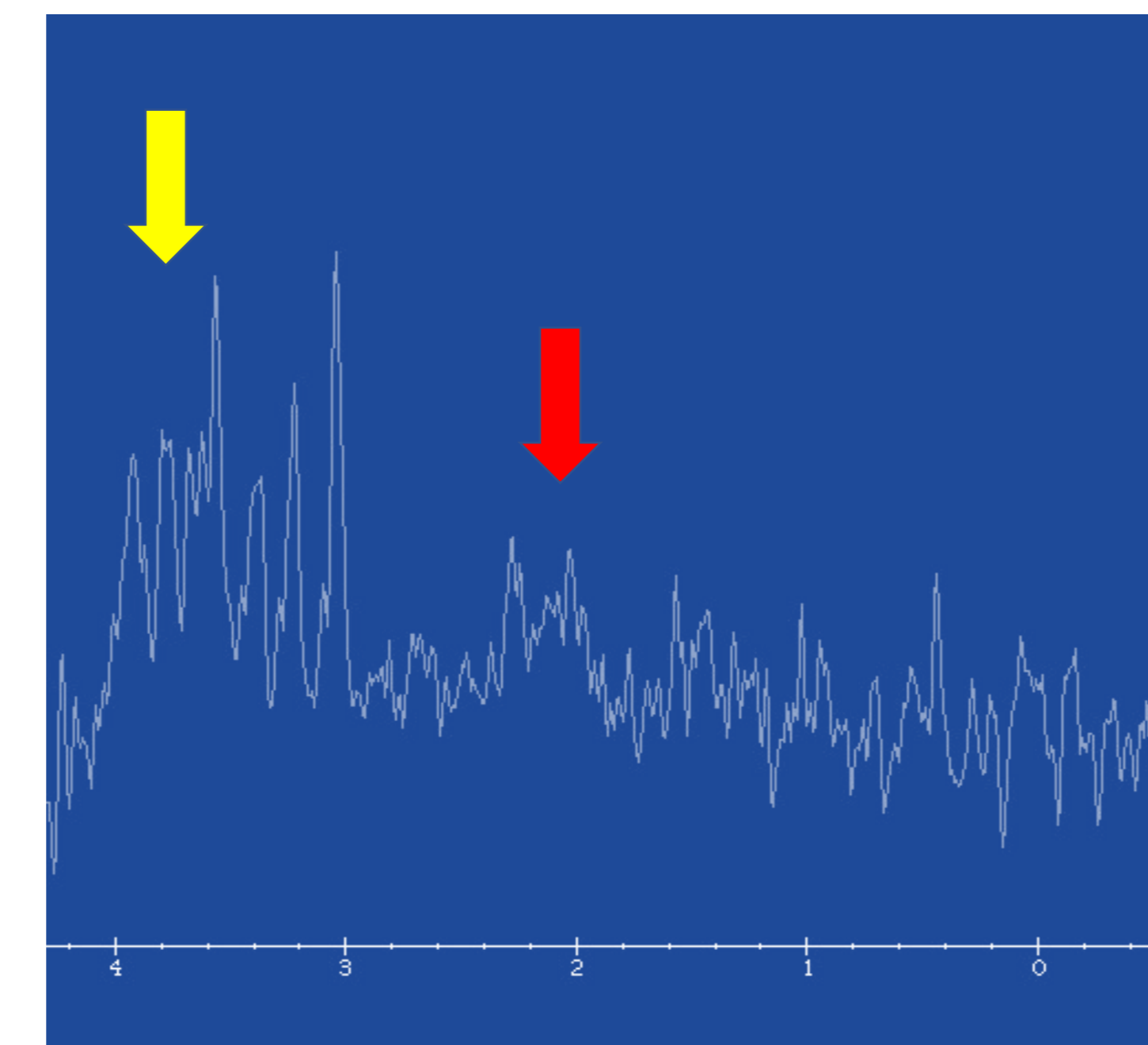
IMAGING

MRI of the sella turcica: Lobular mass of 2.82*2.42*2.4 cm with slight heterogeneity, signal intensity similar to grey matter (T1), with no contrast enhancement located in the hypothalamic-suprasellar-mamillary bodies region of the brain, extending to the wall of the 3rd ventricle and in contact with the anterior lobe of the pituitary gland. Differential diagnosis: hamartoma, glioma, craniopharyngioma



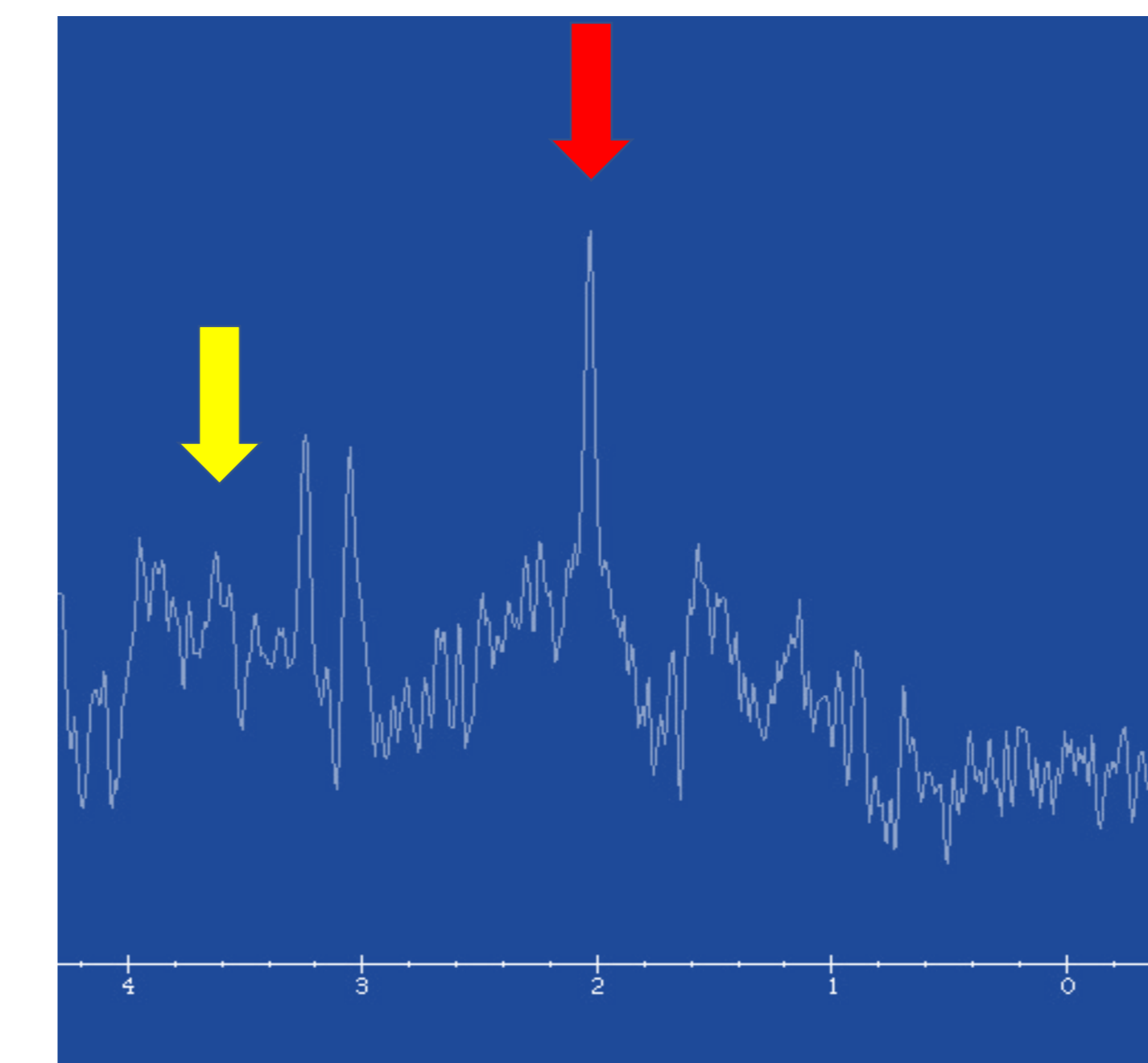
In vivo Magnetic Resonance Spectroscopy: The metabolites that were detected were N-acetyl aspartate (NAA), creatine (Cr), choline (Cho) and myoinositol (MI), as well as lipids and macromolecules. Compared to the spectrum of healthy controls, the NAA / Cr quotient was lower (30% of normal), the Cho / Cr quotient was normal and the MI / Cr quotient was slightly elevated.

Spectrum of the hamartoma



Myoinositol N-acetylaspartate

Control spectrum



Diagnosis: Hypothalamic hamartoma

Treatment: GnRH analog, carbamazepine, topiramate, valproic acid

Follow-up: LH: 0.43 mIU/ml, testo<0.025 mg/ml, testicular volume: 2 ml bilaterally. Gelastic and focal seizures continue.

DISCUSSION

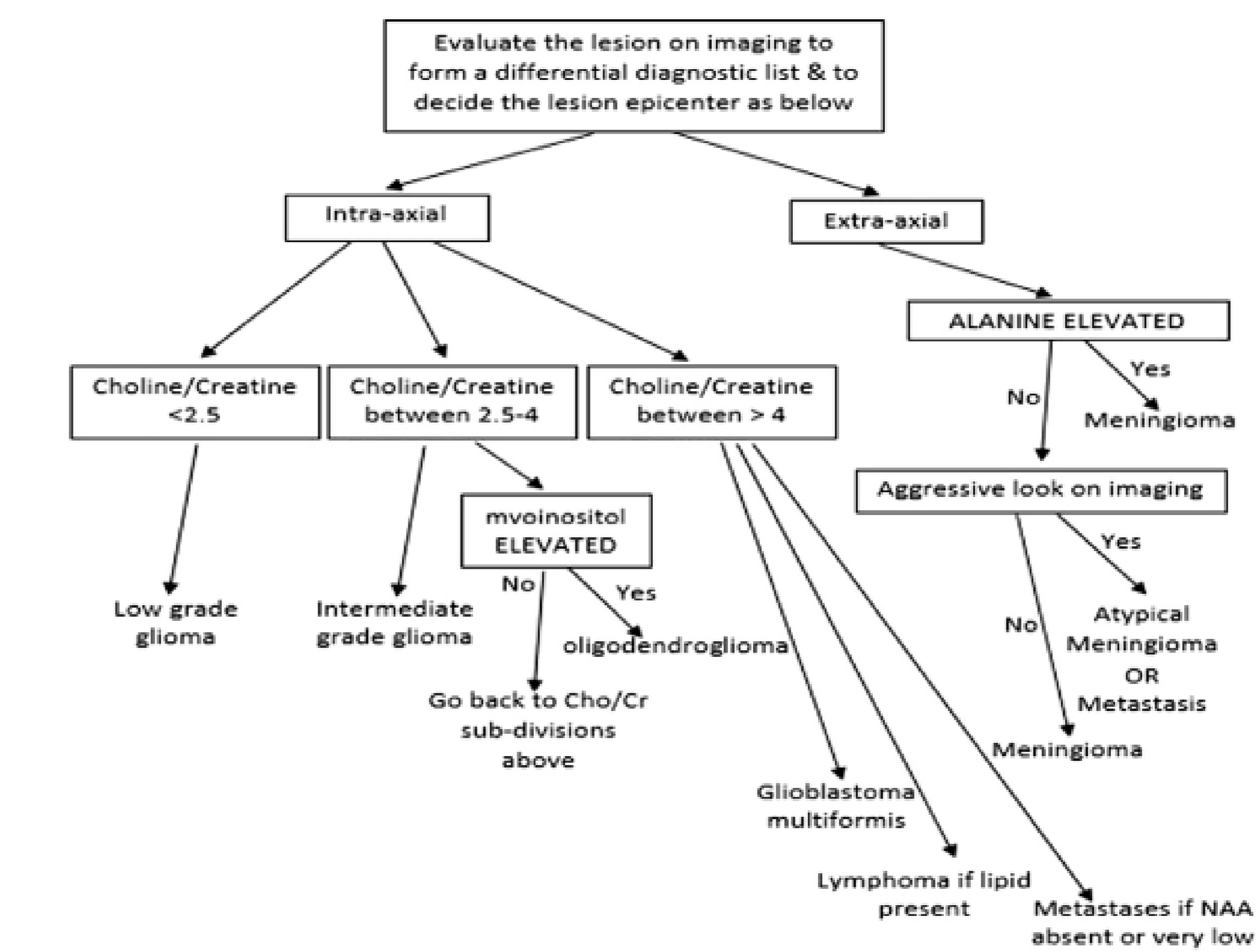
The basic principle of MRS is that the distribution of electrons within an atom cause nuclei in different molecules to react differently under the effect of a magnetic field. This results in slightly different resonant frequencies and, subsequently, a slightly different signal. The unique spectra created by the peaks of the identified metabolites from pathological brain regions add specificity to the identification of the lesion and even improve our ability to detect glial content and to predict histological grading.

Metabolite concentrations (mean \pm SD) in hypothalamic hamartomas compared to the thalamus and frontal lobe of healthy controls.

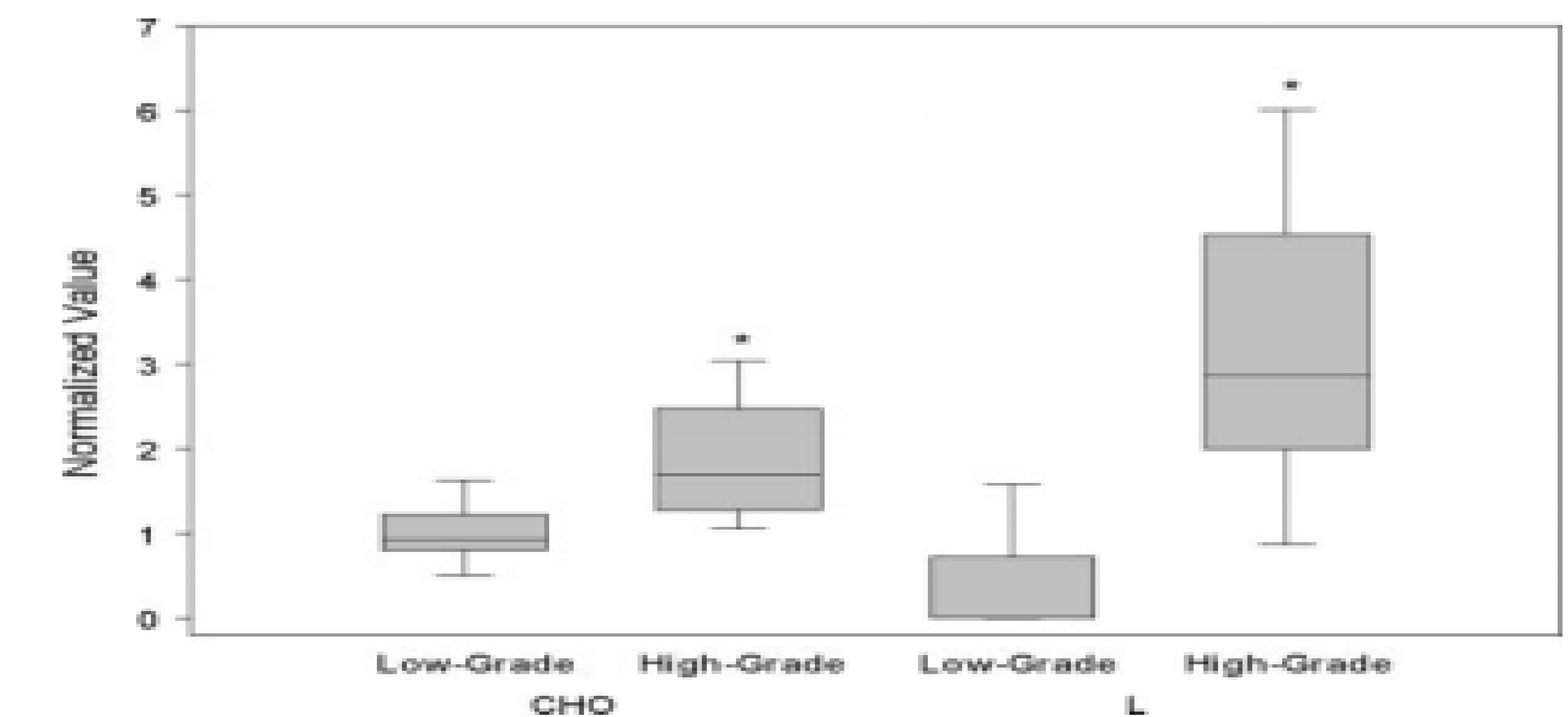
Metabolite	Hamartoma (n=19)	Thalamus (n=10)	Frontal lobe (n=10)
Choline	0.93 \pm 0.25	0.94 \pm 0.18	0.88 \pm 0.06
Creatine	2.88 \pm 0.80	3.25 \pm 0.66	2.74 \pm 0.21
Myoinositol	3.46 \pm 1.24	2.06 \pm 0.42*	2.25 \pm 0.25*
N-acetylaspartate (NAA)	3.01 \pm 1.00	5.44 \pm 0.92**	4.56 \pm 0.31*
Glutamic&Glutamate	5.58 \pm 1.92	6.73 \pm 1.33	5.08 \pm 0.74

Adapted from Freeman et al. *p:0,01 **p:0.001

- In gliomas, NAA and creatine decrease, while choline, lipids and lactate increase. Non glial tumours have small NAA peaks.
- Brain areas affected with radiation show a decrease in NAA, choline and creatine. Tumour recurrences exhibit high choline peaks.



MRS based proposed diagnostic algorithm for lesion differential diagnosis from Verma et al.



Box plots illustrating that normalized values of choline (Cho) and lipids/lactate (L) differentiate high-grade versus low-grade tumors in children from Astrakas et al.

DISADVANTAGES

The method is sensitive to inherent and external factors (i.e. movement) that reflect on the spectrum by creating overlapping peaks or by disturbing the intensity of the signal, complicating thus the interpretation of the spectrum. Moreover, metabolites with low concentrations or with a brief signal duration, may not be detected.

REFERENCES

- Verma et al., BBA Clinical 2016, 2. Astrakas et al, Clinical cancer Research 2004, 3. Amstutz et al. Am J Neurardiol 2006, 4. Freeman et al., Am J Neuroradiol 2004, 5. Alomari et al., Clinical Neurology and Neurosurgery 2020

