Supplementary Material

Supplementary Data 1: Tumour Board Diagnoses

Tumour Board Diagnosis	Number	Histopathological diagnosis available	Central Histopathology Review requested	Histopathology inconclusive
Supratentorial	**40**	**24**	**8**	**4**
Anaplastic Astrocytoma	1	1	**0**	**0**
ATRT	3	3	0	0
Diffuse astrocytoma	1	1	1	0
DNET	3	2	1	0
Germinoma	1	0	0	0
Glioblastoma multiforme	1	1	0	0
Mixed germ cell tumour	1	1	0	0
Meningioma	1	0	0	0

Teratoma	2	2	0	0
Optic pathway glioma	2	0	0	0
Pilocytic astrocytoma	4	4	0	0
Pilomyxoid astrocytoma	1	1	1	0
Pituitary macroadenoma	1	1	1	0
Supratentorial PNET	2	2	2	0
Supratentorial ependymoma	1	1	0	0
Non-malignant: (2=cortical dysplasia, 1=pineal cyst, 1=epidermoid cyst, 6= incidental lesions)	10	2	0	0
Diagnosis Uncertain: (1= possible astroblastoma, 2= possible tectal plate glioma, 2= possible low grade glioma	5	0	0	4 (1 unbiopsied)
Posterior Fossa	**17**	**14**	**0**	**0**
Medulloblastoma	6	6	0	0

Ependymoma	1	1	0	0
Pilocytic Astrocytoma	7	7	0	0
Non-malignant (incidental lesions)	3	0	0	0
Brainstem	**7**	**1**	**0**	**0**
DIPG	5	1	0	0
Low Grade Glioma	2	0	0	0
Total	**64**	**39 (61%)**	**8 (8/39= 21%)**	**4 (4/39 = 10%)**

Supplementary Data 2: Diagnosis of CNS lesions by tumour type using MRI alone, MRI+MRS and histopathology

Tumour Board Diagnosis	Number	Total 'correct' MRI	Total 'partially correct' MRI	Total 'correct'+'partially correct' MRI	Total 'incorrect' or 'inconclusive' MRI	Total correct MRI+MRS	Total 'partially correct' MRI confirmed by MRS	Total 'incorrect' or 'inconcluvie' MRI correctly diagnosed by MRS	MRS 'incorrect'	Change in management resulting from MRS
Supratentorial	**40**	**6**	**11**	**17**	**23**	**24**	**7**	**8**	**2**	**17**
Anaplastic Astrocytoma	1	0	0	0	1	0	0	0	**0**	n=1: MRS confirmed high grade lesion: guided MRT decision to aim for complete resection
ATRT	3	0	0	0	3	0	0	0	1 (ependymoma)	n=1: Incorrect MRS diagnosis – did not alter management
Diffuse astrocytoma	1	0	1	1	0	1	0	0	0	n=1: MRS used to successfully guide biopsy of a heterogeneous lesion (CSI)
DNET	3	0	1	1	2	3	1	2	0	n=1: MRS suggestive of DNET (high mIns) avoided biopsy
Germinoma	1	1	0	1	0	1	0	0	0	
Glioblastoma multiforme	1	0	0	0	1	0	0	0	0	
Mixed germ cell tumour	1	0	1	1	0	1	1	0	0	n=1: MRS used to answer clinical question regarding diagnosis of bifocal or metastatic disease. Bifocal disease diagnosed resulting in treatment with proton beam RT rather than CSI.
Meningioma	1	1	0	1	0	1	0	0	0	
Teratoma	2	1	0	1	1	2	0	1	0	

Optic pathway glioma	2	1	1	2	0	2	1	0	0	n=1: metastatic OPG diagnosis uncertain using MRI alone. Confirmation with MRS allowed commencement of LGG protocol without biopsy.
Pilocytic astrocytoma	4	1	1	2	2	2	0	0	0	
Pilomyxoid astrocytoma	1	0	0	0	1	0	0	0	0	
Pituitary macroadenoma	1	0	0	0	1	0	0	0	0	
Supratentorial PNET	2	0	1	1	1	1	0	0	1 (ependymoma)	n=1: Incorrect MRS diagnosis – did not alter management
Supratentorial ependymoma	1	0	0	0	1	1	0	1	0	n=1: MRS suggested ependymoma, guided surgical planning to aim for complete resection
Non-malignant: (2=cortcal dysplasia, 1=pineal cyst, 1=epidermoid cyst, 6= incidental lesions)	10	1	5	6	4	9	4	4	0	n=8: Confident diagnosis of benign lesions made with addition of MRS. These diagnoses were uncertain using MRI alone. Avoided biopsy in 8 patients
Diagnosis Uncertain: (1= possible astroblastoma, 2=possible tectal plate glioma, 2=possible low grade glioma	5	0	0	0	5	0				n=2: Unusual MRS in possible astroblastoma and possible tectal plate glioma alerted to unusual pathology. Close monitoring enabled early detection of aggressive course. n=2:MRS suggestive of low grade lesions in 2 possible low grade gliomas – MDT decision to observe
Posterior Fossa	**17**	**9**	**6**	**15**	**2**	**16**	**4**	**1**	**0**	**2**
Medulloblastoma	6	3	3	6	0	6	2	0	0	0

Ependymoma	1	0	1	1	0	1	1	0	0	n=1: Confirming ependymoma preoperatively allowed surgical planning of complete resection. Intraoperative histopathology was inconclusive in this case.
Pilocytic Astrocytoma	7	6	1	7	0	7	1	0	0	
Non-malignant (incidental lesions)	3	0	1	1	2	1	0	1	0	n=1: Avoidance of biopsy in non-malignant lesion
Brainstem	**7**	**3**	3	**6**	**1**	**7**	**3**	**1**	**0**	**4**
DIPG	5	3	2	5	0	5	2	0	0	n=2: confirmation of DIPG diagnosis when MRI uncertain, allowed family discussions and referral to RT
Low Grade Glioma	2	0	1	1	1	2	1	1	0	n=2: Atypical MRS profile of pontine lesions alerted clinicians to diagnosis of LGG rather than DIPG. No radiotherapy given. n=1 observed (stable), n=1 treated on LGG protocol (stable)
Total	**64**	**18 (28%)**	**20 (31%)**	**38 (59%)**	**26 (41%)**	**47 (73%)**	**14 (14/38 = 37%)**	**10 (10/26 = 38%)**	**2**	**23 (36%)**

Supplementary Data 3: Diagnosis of CNS lesions managed without histopathology

Reason for lack of histopathological diagnosis	Tumour Location	Tumour Board Diagnosis	Diagnosis facilitated by MRS	Initial diagnosis modified by MRS	Management changed by MRS
Unbiopsied n=21 (33% all patients)	Supratentorial n=14; Posterior fossa n=1 Brainstem n=6	Indolent lesions n=11 (incidental lesions n=9, cortical dysplasia n=2)	n=9 indolent lesions MRS confirmed non-malignancy	n=9 confirmed diagnosis: conventional MRI diagnosis uncertain	n=9 confident MRS diagnosis of non-tumour avoided biopsy in indolent lesions
			n=2 indolent lesions MRS unavailable – decision for conservative management based on conventional imaging		
		Optic pathway glioma n=2	n=1: Confirmed optic pathway glioma (metastatic)	n=1 confirmed diagnosis: conventional MRI diagnosis uncertain	n=1: Avoided biopsy in metastatic optic pathway glioma in patient with multiple comorbidities.
		DNET n=1	n=1: Confirmed DNET (high mIns)	n=1 confirmed diagnosis: conventional MRI diagnosis uncertain	
		Germinoma n=1	MRS diagnosis not documented		
		DIPG n=4	n=2: Confirmed DIPG (conventional MRI diagnosis uncertain)	n=2 confirmed diagnosis: conventional MRI diagnosis uncertain	
		Low grade glioma n = 2	n=2: Confirmed low grade glioma	n=1 confirmed diagnosis: conventional MRI diagnosis uncertain	n=1: pontine lesion misdiagnosed as DIPG using MRI alone was reclassified as LGG following MRS. The child was treated on the LGG protocol and remains stable 16months after diagnosis.
				n=1 Re-diagnosis. Pontine lesion misdiagnosed as DIPG by MRI reclassified as LGG following MRS. Atypical	

				MRS profile was suggestive of LGG. Diagnosis of LGG was verified through clinical course.	
Inconclusive histopathology n = 4 (6% all patients)	Supratentorial n=4	Possible tectal plate glioma n=2; Possible astoblastoma n=1; Possible low grade glioma n=1	n=1: Alerted to high grade tumour (possible astroblastoma) in lesion initially thought low grade on conventional MRI and histopathology n=1: Confirmed low grade glioma where MRI diagnosis uncertain	n=2 Unusual MRS profiles alerted clincians to unusual tumour types. n=1: MRI diagnosis of tectal plate glioma. Histopathology inconclusive. Atypical MRS profile indicated tectal plate glioma unlikely. n=1: MRI diagnosis of tectal plate glioma. Histopathology inconclusive (possible low grade glioma.: Central review possible astroblastoma). MRS profile not typical of tectal plate or low grade glioma alerting clinicians to unusual high grade tumour type.	n=1: MRI diagnosis tectal plate glioma. Atypical MRS profile resulted in close observation and early detection of increase in size. n=1: MRI diagnosis tectal plate glioma. MRS profile unusual alerting clinicians to unusual tumour type. Close monitoring enabled early detection of rapid increase in size and metastatic spread.
Total n=25 (39% all patients)		**21 (21/25 = 84%) (consensus TB diagnosis)**	**17 (17/25 = 68%) (MRS facilitated diagnosis)**	**3 (3/25 = 12%) (MRS modified diagnosis)**	**13 (13/25 = 52%) (MRS altered management)**

Supplementary Data 4: Diagnosis of CNS lesions managed without histopathology

	Percentage (number)	Notes
Number of patients without histopathology	39% (25)	
TB consensus diagnosis reached	84% (21)	Diagnostic uncertainty: 16% (4)
MRS contributed to TB diagnosis	68% (17)	MRS modified diagnosis: 12% (3)
MRS influenced management	52% (13)	• Avoiding biopsy (10) • Revision of diagnosis with subsequent appropriate management (1) • Alerting to high-grade behaviour of lesions initially thought low grade (2).

Supplementary Data 5: Diagnosis of indolent lesions

	Number	Percentage
Number of indolent lesions	13 (Supratentorial 10; Posterior Fossa 3)	20% total
Indolent lesions diagnosed non-invasively	11	85%
Indolent lesions diagnosed following MRI alone	6 (all 'partially correct')	46%
Indolent lesions diagnosed following MRI+MRS	10	77%
Malignant lesions misclassified as indolent using MRS	0	0
Indolent lesions biopsied	2 (AV malformation; epidermoid cyst)	15%
Management changed by MRS	10 (avoided biopsy)	10/11 unbiopsied = 91% noninvasive diagnoses confirmed using MRS