WEST MIDLANDS
IMAGING NETWORK

MEDICAL PHYSICS REGIONAL SCIENTIFIC MEETING

2023

County Hospital Postgraduate Medical Centre, Weston Rd, Stafford ST16 3SA

22nd September 2023
09:30 - 16:00

NHS

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ABOUT THE WEST MIDLANDS IMAGING NETWORK

The West Midlands Imaging Network (WMIN) is a membership organisation designed with collaboration at its heart that will support the delivery of the National Imaging Strategy

There are 22 Imaging Networks in the Country and West Midlands Imaging Network is the largest network in England. WMIN consists of 15 NHS Trusts and 6 Integrated Care Systems, covering a population of over 6 million.

Networks are used to bring together stakeholders across traditional professional and geographic boundaries. We work with partners to support a collaborative, networked approach to the planning, design, and delivery of integrated, holistic, person-centred care pathways.

High-level key aims of the programme are to improve service resilience, reduce duplication and use economies of scale to enable the latest technology to be purchased in order to develop imaging service provision. The Network will work to reduce variation in practice, enhance workforce opportunities, and bring equity to patient access.

Birmingham Women's and Children's NHSFT	Robert Jones and Agnes Hunt Orthopaedic NHSFT	University Hospitals Coventry and Warwickshire NHST
George Eliot Hospital NHST	Royal Orthopaedic Hospital NHSFT	University Hospitals of North Midlands NHST
Sandwell and West Birmingham Hospitals NHST	The Royal Wolverhampton NHST	Walsall Healthcare NHST
South Warwickshire University NHSFT	The Shrewsbury and Telford Hospital NHST	Worcestershire Acute Hospitals NHST
The Dudley Group NHSFT	University Hospitals Birmingham NHSFT	Wye Valley NHST

MORNING PROGRAMME

Time		Presenter	Room
09:30	**Registration and tea and coffee**		Concourse
10:00	Welcome	Sarah Prescott and Bahadar Bhatia	Dinwoodie Lecture Theatre
Chair: Bahadar Bhatia			
10:05	Introduction to West Midlands Imaging Network (WMIN)	Kate Burley	
10:15	Introduction to WMIN MP SIG	Nigel Davies	
10:25	An evaluation of quantitative calibration methods for two SPECT-CT systems with the aim of establishing optimal calibration for 177Lu to improve the accuracy of dosimetry for radionuclide therapy	Sarah Qasim	
10:40	Establishing Clinical Dosimetry in PRRT	Lydia Ram	
10:55	Automation of CT image quality tests	Abigail Cocks	
11:10	Determination of Optic Nerve Motion Amplitude using MRI for Calculating Optic Nerve Planning Organ at Risk Volume Margins for Stereotactic Radiosurgery	Sagar Sabharwal	
11:25	Feasibility of Cranio Spinal Irradiation in Halcyon and comparison with Truebeam	Dince Francis	
11:40	**Coffee Break and Networking**		Concourse
Chair: Harry Poole			Dinwoodie Lecture Theatre
12:00	Standardisation of Multi and Bi Parametric Prostate MRI Protocols: Preliminary Audit to Optimisation across UHB Sites	Rebecca Sawbridge	
12:15	Clinical reliability of the “Home Town Walk” paradigm for reproducible memory activation in patients with epilepsy	Rosa Sanchez Panchuelo	
12:30	Assessment of Thermal Index Compliance in Clinical Ultrasound Examinations	Adam Studd	
12:45	Standardisation of MRI Protocols in Multiple Sclerosis across Multiple Scanners Platforms and Hospital Sites	Roya Jalali	
13:00	Determination of metabolite profiles in childhood medulloblastoma and their correlation with age using in vivo 1H magnetic resonance spectroscopy	Zack Ravetz	
13:15	**Lunch and Networking**		Concourse

AFTERNOON PROGRAMME

Time		Presenter	Room
Chair: Sarah Prescott			
14:00	Prize Giving	Kate Burley	Dinwoodie Lecture Theatre
14:05	Reflection Workshop	Harry Poole	
14:35	Progression to HSST	Sam Butler	
14:45	**Break**		
14:50	WMIN Medical Physics Special Interest Group Meeting	Chair: Nigel Davies	Dinwoodie Lecture Theatre
14:50	Trainee Networking	Chair: Adam Studd	Room 3
16:00	**Close**		

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WEST MIDLANDS
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10:25- 10:40 CALIBRATION OF SPECT-CT SYSTEMS FOR QUANTITATIVE IMAGING OF LU-177 FOR DOSIMETRY. CLIDE THERAPY

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177Lu is used for peptide-receptor radionuclide therapy (PRRT) to treat neuro-endocrine tumours. SPECT (Single. Positron Emission Computed Tomography) systems used to image 177Lu post-therapy are not intrinsically quantitative. Calibration of systems must be performed to determine the true activity of 177Lu uptake seen in patient images. Activity is used to calculate the radiation dose to tissues. Calibration determines a factor to convert the counts obtained from a SPECT image to the true activity in Becquerels (Bq) in that voxel using a calibration factor (CF). CFs vary depending on characteristics of the system and method of calibration.

CFs were calculated for two Siemens SPECT-CT systems (Symbia T2 and Pro.specta x7). Performance and ability to recover activity from subsequent quantitative SPECT images was assessed. Two calibration geometries were used to derive CFs – a cylinder containing homogeneous distribution of activity; and a radioactive sphere within a scatter medium. Recovery coefficient (RC) curves were plotted as a function of VOI volume to compare the effect of reconstruction parameters on activity recovery. RC curves were fitted to derive a function to correct for partial volume effects (PVE). A correction for dead-time effect was also investigated. The optimal calibration method was found to be a cylinder calibration geometry with an OSEM reconstruction of 10 iterations and 8 subsets. Quantitative SPECT activity was recovered to within 15% of the known activity for an anthropomorphic liver with a hot lesion within it (with PVE corrections). PVE corrections improved activity recovery from an underestimation of 30% to 15%. Poor RC curve fitting and CT-based delineation are likely causes of underestimation even with PVC applied, as observed on Symbia T. A dead-time correction technique has shown promising results for the Siemens Pro.specta

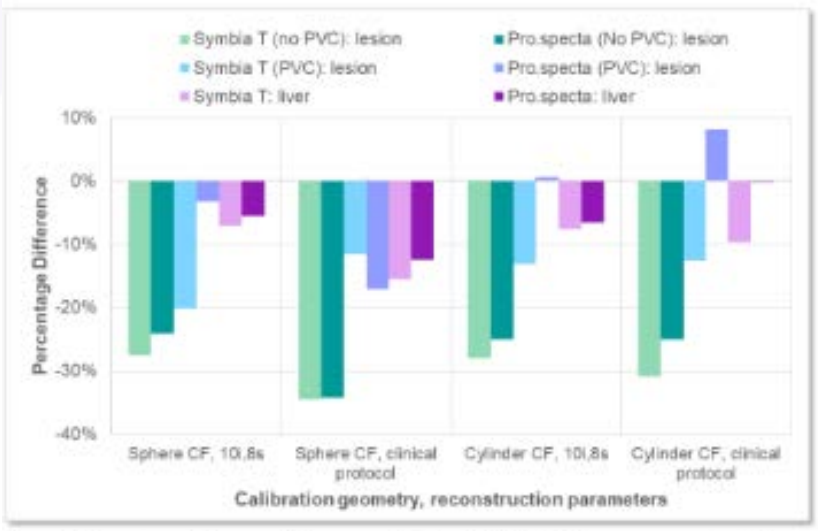

Figure 1: Percentage difference between quantitative SPECT activity measurements and known activity.

10:40-10:55

ESTABLISHING CLINICAL DOSIMETRY IN PRRT

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Peptide receptor radionuclide therapy (PRRT) with 177Lu-DOTATATE is a standardised therapy administered over 4 cycles with 7400 MBq given at each. IRMER legislation and the2013/59/Euratom Directive require that target radiation doses are individually planned [1, 2]. Compliance is achieved by performing retrospective dosimetry. The project aims were to establish a clinical dosimetry service, calculate absorbed dose (AD) for kidneys (the known organ at risk) and tumour deposits, and assess whether maximum standardised uptake value (SUVmax) can be used to predict AD.Dosimetry was applied to 20 patients undergoing PRRT. After cycle 1, patients underwent quantitative SPECT/CT (QSPECT/CT) 4 hours post-administration and SPECT-only imaging on days 1, 4 and 7. Tumour deposits were selected based on RECIST criteria [3], maximum axial diameter ≥ 20mm on the pre-PRRT contrast enhanced CT, and SUV ≥ 6. AD was calculated with voxel-based dosimetry for selected tumour deposits and the kidneys. Tumour SUVmax values were measured and compared with AD.Mean AD and SUVmax for 37 suitable tumour deposits were calculated across 19 patients: mean AD (± standard deviation) was 14.4 (± 10.2) Gy, mean SUVmax was 21.4 (± 11.6). There was weak correlation between AD and SUVmax (R = 0.21). Mean kidney AD was 3.5 (± 1.1) Gy for the left kidney and 3.9 (± 1.3) Gy for the right; four-cycle AD estimates were 14.0 Gy and 15.6 Gy, respectively, which were within the 23 Gy external beam radiotherapy limit [4].

In conclusion, cycle 1 AD and SUVmax were obtained for 37 tumour deposits. SUVmax in QSPECT/CT images should not be used to estimate tumour AD. Kidney doses were within the 23 Gy radiotherapy limit for 95% of patients. A clinical dosimetry service has been established but further investigation between absorbed dose and tumour marker parameters is required.

References:

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10:55 - 11:10

AUTOMATION OF CT IMAGE QUALITY TESTS

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CT scans used to plan a patient's radiotherapy treatment must display a high level of image quality and geometric accuracy. The script presented automates the monthly quality control (QC) tests performed by radiotherapy staff to assess that scanner image quality performance remains within tolerance, bringing with it four key benefits to the workflow:

- Staff time required to perform the tests is greatly reduced.
- The time the scanner has to be taken out of clinical use for testing is reduced.
- The results of the tests are standardised, since any human error or bias is removed.
- The test records are automatically saved in an electronic form, as opposed to the current paper records.

Furthermore, the script can be utilised by software in radiotherapy departments used for recording QC results and that has the capability for Python scripting, such as QATrack+. This software has the ability to receive DICOM files from a server, and so the person performing the QC test only needs to image the phantom and export the scan to the DICOM server. When the test is initiated in QATrack+ it will automatically locate and read the DICOM files and run the script. The results are then checked against the predefined tolerances. Regions of interest used in these automated QC tests are shown on the DICOM images within this test so that they can be assessed by the user if required. This script has been validated against previous QC tests that have been manually performed. The intention is for the work presented here to be extended to include the Cone Beam CT image quality QC tests, further streamlining the tests performed at our radiotherapy centre

11:10-11:25

DETERMINATION OF OPTIC NERVE MOTION AMPLITUDE USING MRI FOR CALCULATING OPTIC NERVE PLANNING ORGAN AT RISK VOLUME MARGINS FOR STEREOTACTIC RADIOSURGERY

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Optic nerves may move into regions of high dose when treating perioptic lesions using radiotherapy, putting them at risk of radiation induced damage. There are sharp dose gradients in stereotactic radiosurgery (SRS) and minute optic nerve motion may increase dose to the optic nerves. This risk could be reduced by adding a planning organ at risk volume (PRV) around the nerve during treatment planning. A 3T MRI scanner was used to image 10 healthy volunteers. 6 axial scans of volunteers looking straight ahead, up, down, straight ahead again, left and right were acquired. These images were rigidly registered and then 3 points of interest were placed along the optic nerve to measure motion.

The mean optic nerve motion amplitude measured near the retina in the left-right and up-down directions were found to be 5.7 ± 0.9 mm and 3.9 ± 0.7 mm respectively for the left optic nerve and 5.7 ± 0.5 mm and 3.9 ± 0.6 mm respectively for the right optic nerve. It was also found optic nerves may move by up to 0.8 ± 0.8 mm when asked to look back at the same point. The optic nerve motion data collected and the uncertainties in the technical accuracy of CyberKnife, an SRS system, were considered in order to calculate optic nerve PRV margins: a non-isotropic margin of mleft/right,PRV = 3 mm, msup/inf,PRV = 2 mm and mAnt/Post,PRV = 1 mm which consider the full range of motion measured in a worst case scenario and an isotropic margin of mPRV = 1 mm which considers a scenario where patients are asked to look neutrally during imaging and treatment. Applying these PRVs to 8 historic sphenoid wing meningioma CyberKnife plans showed a potentially clinically impactful dosimetric difference due to optic nerve motion.

The calculated optic nerve PRV margins have been used to guide the SRS treatment of multiple patients, allowing for dose to the optic nerve to be decreased while taking motion into account, despite the close proximity of the treatment target.

11:25-11:40
A STUDY ON CSI VMAT IN HALCYON – COMPARATIVE DOSIMETRIC ANALYSIS WITH TRUEBEAM

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TA STUDY ON CSI VMAT IN HALCYON – COMPARATIVE DOSIMETRIC ANALYSIS WITH TRUEBEAM
Dince Francis

This study evaluates the volumetric modulated arc therapy (VMAT) dosimetric comparison between Halcyon ring gantry and TrueBeam c-arm linear accelerators for craniospinal irradiation (CSI) of the central nervous system malignancies. Eight patients, who received treatment for medulloblastoma were planned for VMAT in True Beam (TB), and Halcyon (HAL) linear accelerators using 6 MV unflattened (FFF) photon beams .

Dose-volume statistics for the target and organs at risk (OARs) and the total number of monitor units (MUs) in the treatment plans were compared which included dose received by 95% PTV volume (D95%), volume receiving ≥ 107% dose (V107%) , homogeneity index (HI), conformity index , MU and dose spillage . All patients were planned for 36 Gy in 20 fractions. For HALFFF and TBFFF, PTVV95% were 97.5 ± 0.8% and 97.4 ± 0.9% respectively while the V107% were 0.6 ± 0.4% and 0.5 ± 0.5 respectively . However, the number of monitor units showed statistical significance with values of 1331.9 ± 243.4 MU and 1089 ± 206.7 MU respectively for the HAL and TB plans. The differences in spillage dose were also statistically significant, favouring HAL plans . Conformity indices are also reported with HAL = 0.9 ± 0.02 and TB = 0.89 ± 0.03 . For most of the OARs , the mean dose differences were favouring of HAL plans. Halcyon treatment delivery is twice as faster than truebeam plans due to the differences in equipment specifications. Halcyon based VMAT CSI plans are dosimetrically superior in terms of organ dose and offer lower spillage doses than the TrueBeam plans. Technically , one machine outweighs the other and the choice of the suitable equipment should be decided based on the priorities. From clinical perspective, plans generated by Truebeam and Halcyon are suitable for the patients' treatments , which is clinically acceptable .

WEST MIDLANDS IMAGING NETWORK

12:00-12:15

STANDARDISATION OF MULTI AND BI PARAMETRIC PROSTATE MRI PROTOCOLS: FROM PRELIMINARY AUDIT TO OPTIMISATION ACROSS UHB SITES

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Introduction:
Multi and Bi Parametric MR imaging (mpMRI/bpMRI) have been adopted for routine clinical use in the detection and staging of cancer within the prostate (1). Standardisation of protocols for accurate assessment of prostate cancer is required; a difficult process across multiple sites and vendors. Guidelines for bpMRI; T1-weighted, T2-weighted and Diffusion Weighted Imaging (DWI) and mpMRI plus Dynamic contrast-enhanced (DCE) MR imaging of the prostate can be found in PIRADS V2 and the updated V2.1 (2). The project aim was to compare current protocols across UHB sites against this standard as part of a preliminary audit to help inform the optimisation and standardisation of prostate imaging across UHB sites.

Method:
Preliminary audit; PIRADS V2.1 imaging parameters guidelines were used as the standard to compare prostate protocol parameters and quality additionally assessed from images acquired between December2020 and January 2021. The dataset comprised of 4 hospitals with a total of 61 patient images across 7 scanners (2 Siemens, 4 Philips and 1 GE). Image quality was then assessed across 12 scanners used for Prostate imaging across UHB sites using a PIQUAL scoring system for 23 patients imaged between February and March 2023. Iterative optimisation and structured radiology feedback followed to align each scanner with PIRADS V2.1, balancing image quality Vs scan duration to achieve diagnostic standard images.

Results:
The preliminary audit found 2/7 scanners used mpMRI and 5/7 were using bpMRI protocols. Main conflicts with PIRADS V2.1 included DWI parameters and DCE temporal resolution. Movement and patient factors are a key issue affecting image quality. Key areas for optimisation and standardisation were identified and implemented across the different hospitals and scanner types within UHB.

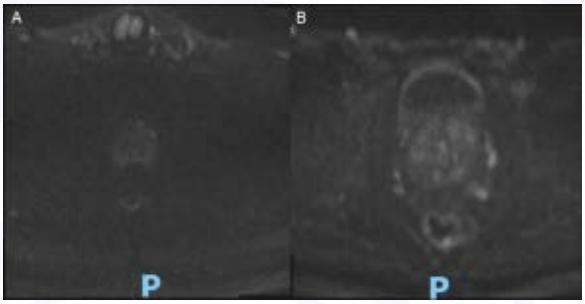

Figure 1 DWI B1400 image at start of optimisation process (A) vs optimised (B) for a Siemens Aera 1.5T scanner showing improved signal between patient A and B

Conclusion:
Following multidisciplinary collaboration and radiology feedback optimised protocols have been achieved for the majority of scanners across UHB sites allowing a stock of good quality diagnostic protocols to be established.

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12:15-12:30 CLINICAL RELIABILITY OF THE NHOME TOWN WALK" FMRI PARADIGM FOR MEMORY FUNCTION LOCALIZATION IN PRE-SURGICAL ASSESSMENT OF PATIENTS WITH EPILEPSY

Rosa Sanchez
STP Trainee

University Hospitals Birmingham Trust

Synopsis:

Memory-activated functional MRI (fMRI) is increasingly implemented in the clinic to assess memory function and inform pre-surgical decision making in refractory epilepsy. The Home Town Walking (HTW) fMRI paradigm has been shown to activate the parahippocampal gyri (PHG) and help determine memory lateralization in epilepsy patients. However, limited data are available on the reliability of this technique in clinical practice. This study aims to assess the robustness of the HTW paradigm for localising and lateralislng memory function in a consecutive clinical series of 117 Temporal Lobe Epilepsy patients. Memory-related activation patterns were observed in 76% of cases with 94% reproducibility.

Introduction:

Memory-activated functional MRI (fMRI) is increasingly implemented in the clinic to assess memory function as part of pre-surgical decision making in refractory epilepsy1 ·5• The Home Town Walking (HTW) fMRI paradigm has been shown to activate the parahippocampal gyri (PHG) and help determine memory lateralization in epilepsy patients3, however limited data are available on the reliability of this technique. This study aims to assess the robustness of the HTW paradigm for lateralising memory function and aiding surgical planning in a large consecutive series of epilepsy patients.

Methods:

fMRI data were collected over 7 years (2015-2022) from 117 epilepsy patients across 2 Siemens 3T scanners (Verio and Skyra) using GE-EPI (3mm isotropic, TR=2s/3s) and a block-design HTW memory paradigm as part of a wider language and memory fMRI assessment. Patients were requested to participate in two fMRI sessions, usually less than 3 days apart (one episode) and were instructed to prepare an imagined but familiar walk prior to the first scanning session. Instructions were given to start and end at familiar places, divide the route into 10 blocks and list at least five memorable scenes or landmarks for each block. During the fMRI scans, patients were asked to visualise and recount their prepared detailed walk in their heads to the best of their abilities during the 30 s Walk' periods, and relax during the 30 s 'Rest' periods. High-resolution 3D T1-weighted scans were also acquired for anatomical reference.

All data were analysed using a General Linear Model (GLM) with the manufacturer's (Syngo VIA) BOLD processing package by a single experienced consultant neuroradiologist who produced a clinical report for surgical planning. The minimum cluster size and the t-statistical map threshold were subjectively varied to optimise a perceived balance between reliable PHG activation and spurious signals for each fMRI dataset. The clinical report included comments on the presence of PHG activation and if it was bilateral or predominantly left or right sided. The fused activation maps from all repeated fMRI sessions were compared and verified by MR physicists, and results compiled from the clinical reports to classify patients according to the reproducibility of the PHG activation pattern. A subset of 32 episodes (31 patients) were then selected from groups of patients who displayed reproducible (Group A) or non-reproducible (Group B) activation patterns and no activation (Group C) in either day within the PHG region. This subset of data were analysed using FSL FEAT (5mm kernel for spatial smoothing, z-score> 3.1, p-cluster=0.05). Activation maps were compared with the scanner generated maps and projected to a reference T1-weighted anatomical volume (collected on day 1) to compare activations across both days. Masks of posterior PHG right and left regions were created from Harvard-Oxford probabilistic atlas, projected to each patient's reference space (using fnirt) and used to interrogate details of the statistical maps and compute Dice Coefficients (DC) across days within these regions.

12:15-12:30

CLINICAL RELIABILITY OF THE NHOME TOWN WALK" FMRI PARADIGM FOR MEMORY FUNCTION LOCALIZATION IN PRE-SURGICAL ASSESSMENT OF PATIENTS WITH EPILEPSY

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Results;

A total of 246 fMRI HTW datasets from 117 patients were assessed, of which 108 patients had repeated the scan at least twice (14 patients had additional follow up scans). BOLD activations were often observed in parahippocampal (PHG) and fusiform gyri, as well as language and visual areas. Figure 1 shows activation maps obtained with SyngoVIA and FSL for both days in two example subjects, and reproducibility on the combined FSL maps across days (intersection shown in yellow). Figure 2 summarizes the results: PHG BOLD activations were observed in at least one of the days for 90 (78%) of the episodes analysed with SyngoVia, with 93% of the PHG activation patterns evoked on day 1 successfully reproduced on day 2. Bilateral PHG activations were seen in 57% of these patients, with 34% and 9% predominantly left and right sided respectively. The additional FSL analysis on a subset of data revealed increased reproducibility of PHG activation patterns across days (when DC > 0.15), which was achieved for 72% of the analysed episodes. Figure 3 shows example of reproducible activation patterns for episodes across the three groups and details for each group of the percentage of reproducible activation, mean volume of the intersection and mean DC across activations from both days within the left and right PHG regions.

Discussion & Conclusion :

Despite being relatively difficult, most patients were able to perform the task given adequate preparation and reproducible PHG activations were achieved in the majority of cases. There was generally good agreement between the clinically processed results and the FSL analysis. However, the FSL analysis showed reproducible activity in 11 out of 17 cases where the clinical Syngovia analysis did not detect reproducible results. This was often the case when a higher threshold by the neuroradiologist due to stronger activation in other areas, as in subject 8 in Fig1, such that PHG regions were missed. FSL and Syngovia results are comparable when a lower t-stat threshold was used. Successful implementation of a repeated HTW paradigm shows reproducible (94% for positive studies) BOLD activations in medial temporal lobes sufficient to lateralise memory function in patients undergoing pre-surgical evaluation, which can be used as an adjunct to neuropsychological memory assessment. Future work will assess the correlation of fM RI results with postoperative memory outcome.

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12:15-12:30

CLINICAL RELIABILITY OF THE NHOME TOWN WALK" FMRI PARADIGM FOR MEMORY FUNCTION LOCALIZATION IN PRE-SURGICAL ASSESSMENT OF PATIENTS WITH EPILEPSY

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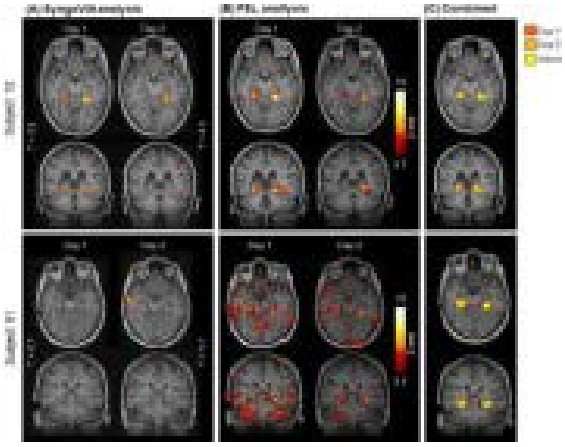
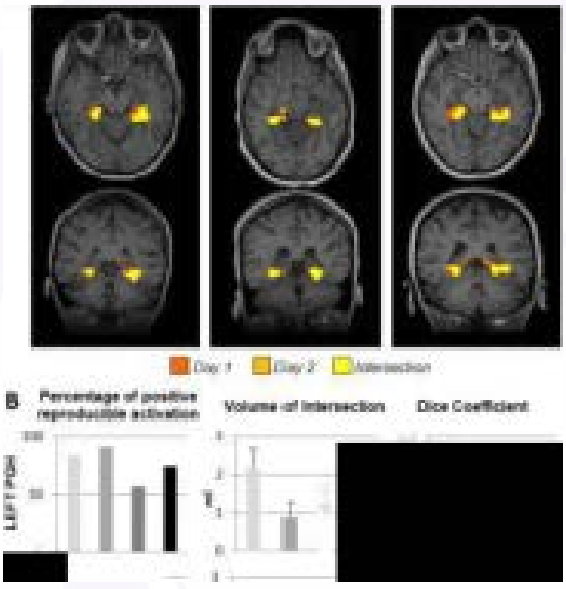
Figures:



Comparison of statistical activation maps evoked by HTW task obtained with (A) SyngoVIA and (B) FSL analysis for two example episodes from Group A (reproducible PHG activity) and Group C (no PHG activation in either day). Maps overlaid onto T1-weithed anatomical MPRAGE from each day. (C) Comparison of FSL activation maps for each day on the patient's reference anatomical volume. Cyan: Probabilistic PHG region.

Number of patients	108	N. with 2 scans	N. with > 2 scans
Number of episodes (2 HTW scans)	116	94	14
Number of episodes with PHG activation	In any day	In day 1	In both days
	90	46	43
Subset analysed with FSL	Group A	Group B	Group C
Number of episodes	13	12	7
Number with reproduced PGH activation	12 (92 %)	7 (58 %)	4 (57%)



(A) Reproducibility of activation patterns evoked by HTW task obtained with FSL analysis for example subjects from Groups A, Band C. (Bl Plots of percentage of reproducible activation pattern, mean intersection volume (ml) and mean Dice Coefficient within left and right PHG regions. Error: Standard error across subjects.

12:30-12:45

ASSESSMENT OF THERMAL INDEX COMPLIANCE IN CLINICAL ULTRASOUND EXAMINATIONS

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Background:

Ultrasound (US) techniques receive widespread clinical use, with many acknowledging the relative safety compared with alternative ionising-based approaches as one key aspect for its success [1]. There are, however, risks associated with the use of US imaging, with guidance released by the British medical ultrasound society (BMUS) to outline methods for safe scanning [2, 3]. As part of this guidance it is highlighted that US users should carefully monitor the thermal index (TI) safety index, corresponding to an estimate of the potential local heating rise. These guidelines state that sonographers should limit scan duration in-line with TI values reported during the examination. It would therefore be beneficial, and indeed prudent, to develop methods of auditing compliance with BMUS guidelines. This work provides an overview
of the approach taken locally to address this need within an NHS trust, presenting the conclusions drawn from an initial audit of US investigations, and the subsequent actions taken as a result of these findings.

Methods:
Working collaboratively with peers in the medical physics department, and following extensive work conducted by Sam Butler (UHNM), an in-house analysis script was created using MATLAB programming software (version 9.10.0.1602886, R2021a) that was capable of anonymising and interrogating DICOM header information to extract TI values. Using this software US imaging events were assessed for compliance with BMUS guidelines, focussing initially on imaging departments over a one week period. An audit report was created to identify breaches of the recommended safety index time limits, followed by an investigation into developments or changes that may help to minimise their frequency. Currently, the focus of this work is to conduct a continuation of the initial audit following these changes, with the aim of comparing the frequency of BMUS guidance breaches pre-and post-audit.

12:30-12:45

ASSESSMENT OF THERMAL INDEX COMPLIANCE IN CLINICAL ULTRASOUND EXAMINATIONS

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Results:
Results will be continually acquired leading to presentation to allow for a more comprehensive representation of the process and outcome. Briefly, current work has demonstrated efficacy of the in-house software, including the identification of several examinations from a specific US scanner system that require further investigation. Discussion with users of the system indicated that these issues related to sub-optimal clinical scanner performance not seen during local quality assurance. This has subsequently been discussed
with the system manufacturer, with the aim of improving settings to prevent further breaches. Future work is focussed on investigating and comparing recent examinations with those assessed as part of the initial audit.

Conclusion:
This work aims to highlight the importance of monitoring compliance with safety guidelines in US departments, and the potential clinical benefit that may be found as a result. Current work provides evidence for a potential approach to address this need, with on-going work assessing the impact on compliance of routine US examinations with BMUS guidelines.

Key Words: Ultrasound (US), Audit, MI, TI

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https://www.bmus.org/static/uploads/resources/BMUS-Safety-Guidelines-2009-revision-FINAL-Nov 2009.pdf. [Accessed 3 May 2022]

12:45-13:00

STANDARDISATION OF MRI PROTOCOLS IN MULTIPLE SCLEROSIS ACROSS MULTIPLE SCANNERS PLATFORMS AND HOSPITAL SITES

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Introduction:
The 2017 revisions of the McDonald criteria on multiple sclerosis (MS) diagnosis reinforced the importance of brain and spinal cord MRI examinations and the strong need for a standardisation of acquisition and interpretation to avoid misdiagnosis. Therefore, the 2021 MAGNIMS–CMSC–NAIMS consensus has been developed to provide guidance for consistency in MRI scanning protocols for MS patients. This guidance recommends T2w, T2 FLAIR and post-contrast T1w sequences for the brain, T2w and T2 STIR and post-contrast T1w for the spinal cord along with some optional sequences such as proton density (PD) and Diffusion Weighted imaging (DWI). The aim of this work is to assess the quality and variability of MS protocols across hospital sites at UHB with different MRI scanner manufacturers, field strengths, models and software levels. To achieve this, we are carrying out a quality audit with reference to the current departmental protocol and in comparison with the 2021 MAGNIMS–CMSC–NAIMS consensus statement, while in parallel working to improve the protocols based on the findings.

Methods:
Initial investigations were carried out by exporting MS protocols from the scanners and comparing the main parameters against the consensus guideline (table 1), such as acquisition type (2D/3D), orientation plane, slice thickness, and slice gap. We have also registered a clinical audit and created a spreadsheet tool to collect detailed information from scans of MS patients across scanners and sites for comparison and image quality evaluation. Data collection is ongoing but we have so far compared protocols from 7 scanners and collected feedback on suboptimal images and issues for improvement from three neuroradiology consultants.

Table 1. The basic details of 2021 MAGNIMS- CMSC-NAIMS standardized MRI protocol .

	Brain	Spinal cord
Field strength	≥1.5 T (preferably 3T)	≥1.5 T (preferably 3T)
Acquisition	3d (preferred) or 2d	3d (preferred) or 2d
slice thickness	3d: 1mm isotropic 2d: ≤3mm, no gap	Sagittal: ≤3mm, no gap Axial: ≤5mm, no gap
In-plane resolution	≤1mm x 1mm	≤1mm x 1mm
Coverage	whole brain	whole cord
Axial scan orientation	Subcallosal plane	Perpendicular to sagittal axis of cord

Results and Discussion:
Data collection is ongoing, however, our interim analysis found variations in slice thickness and slice gap, quality and contrast of 3D FLAIR, 2D versus 3D acquisition of T1w before and after contrast and the timing of T1w scans after contrast injection. Specific feedback was received from neuroradiologists regarding suboptimal quality and contrast in 3D FLAIR and artefacts obscuring the spinal cord on Sag T2w STIR. Optimisation of the sequence parameters is ongoing to address these issues on specific scanners. Quality comparisons of post-contrast T1w sequences are confounded by variations in sequence order and time delays. Further work is ongoing to address this by asking radiographers to record the time of the contrast injection and post-contrast T1w scans across UHB.

References:
(1) Thompson AJ,et al: 2017. Lancet Neurol 17:162–173, (2) Mike P Wattjes, et al. 2021. Lancet Neurol; 20: 653–70 , (3) Valentina Tomassiniet, et al., 2020. Journal of Neurology 267:2917–2925.

13:00-13:15

DETERMINATION OF METABOLITE PROFILES IN CHILDHOOD MEDULLOBLASTOMA AND THEIR CORRELATION WITH AGE USING IN VIVO 1H MAGNETIC RESONANCE SPECTROSCOPY

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Background:

Medulloblastoma is the second most common brain tumour found in children; it is a grade IV tumour meaning it is cancerous and fast growing. As part of the diagnostic pathway most patients have an MRI scan and may have magnetic resonance spectroscopy (MRS) completed as part of this. MRS of a tumour can provide clinical insight into the tumour, by giving clinicians information about the metabolites within it. This research hopes to improve this insight and open new pathways for future research by filling the gap in the knowledge surrounding how medulloblastoma presents in clinical in vivo 1H MRS at different ages.

Methods:

This research was completed by retrospectively analysing data collected during the clinical diagnostic and treatment process for medulloblastoma at Birmingham Children's Hospital. Patient ages ranged from 1 to 14 and were scanned on both 1.5T and 3T scanners. Raw spectroscopy data was collected from the CCLG[1] database and processed in TARQUIN [2] to find metabolite concentrations. Regression modelling was used to determine if any significant correlation exists between concentration and patient age.

Results and Discussion:

The results agree with previous research showing increases in total choline concentration with age [3], however they also indicate that this change is specific to male patients only, as shown in figure 1a. Other key findings are that glutamate appears to negatively correlate with age irrespective of gender, and creatine appears to decrease with age for female patients. These results suggest that some medulloblastoma metabolite concentrations change with age, and that these changes may be gender specific. These findings may influence the design of clinical decision support tools based on MRS data.

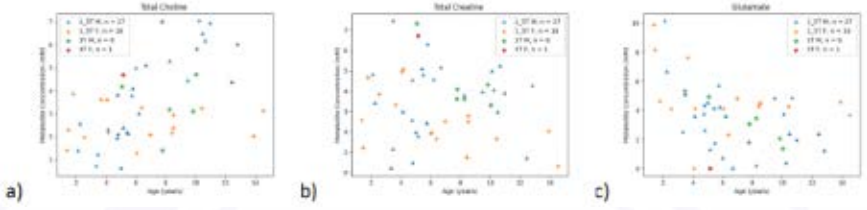
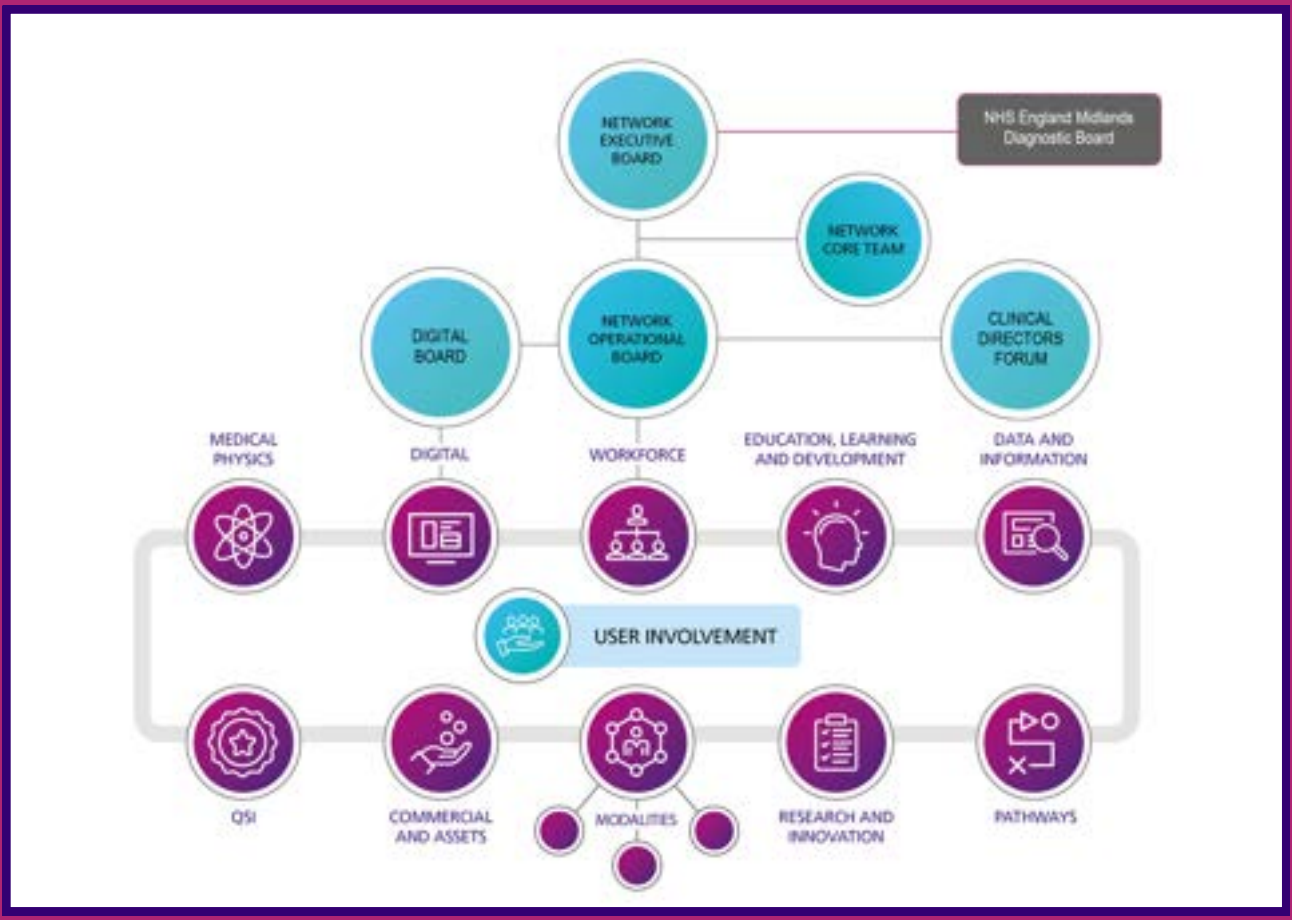


Figure 1. Concentration vs age for a) total choline, b) total creatine, and c) glutamate.

[1] Children's Cancer and Leukaemia Group. https://www.cclg.org.uk/. (Accessed on 07/16/2023).
[2] Wilson M. et al. "A constrained least-squares approach to the automated quantitation of in vivo 1H magnetic resonance spectroscopy data". Magn Reson Med 65.1 (2011), pp. 1–12.
[3] Davies N. et al. "Effects of age on brain tumour metabolite levels measured by in-vivo 1H MRS in children and young people are tumour type specific".In Proc. Intl. Soc. Mag. Reson. Med. 21 (2013), Salt Lake City, US, 970.

Acknowledgments: Children's Cancer and Leukaemia Group, Birmingham Children's Hospital Radiology Department (lead radiographer Moira Perrins) and, the Children's Brain tumour Research Team



Medical Physics Special Interest Group

In order for the Network to delivers our strategy, a governance framework is in place incorporating a number of Boards and Expert Groups representing the entirety of the region.

The Medical Physics Special Interest Group (MPSIG) allows Medical Physics centres within region to:

- Discuss issues related to the delivery of services across the region
- Receive information and provide representation from the operational board and other relevant groups
- Promote collaboration between the member centres on the provision of Medical Physics services and the sharing of relevant information

The group has created an initial workplan and are focussed on to:

- Review of and planning for the Imaging Physics workforce
- Training of the Medical Physics workforce including Clinical Scientists and Technologists
- Provision of training to Radiologists, Radiographers and other staff groups
- The procurement, quality assurance and optimisation of Imaging equipment within the West Midlands region

MEDICAL PHYSICS SIG MEETING AGENDA

Chair: Nigel Davies		
14:50	Previous Meeting Minutes and actions	Nigel Davies
14:55	Network Update	Holly Warriner
15:05	Workforce	Harry Poole
15:50	Chair Arrangements	Nigel Davies
15:55	AOB	
16:00	**Close**	

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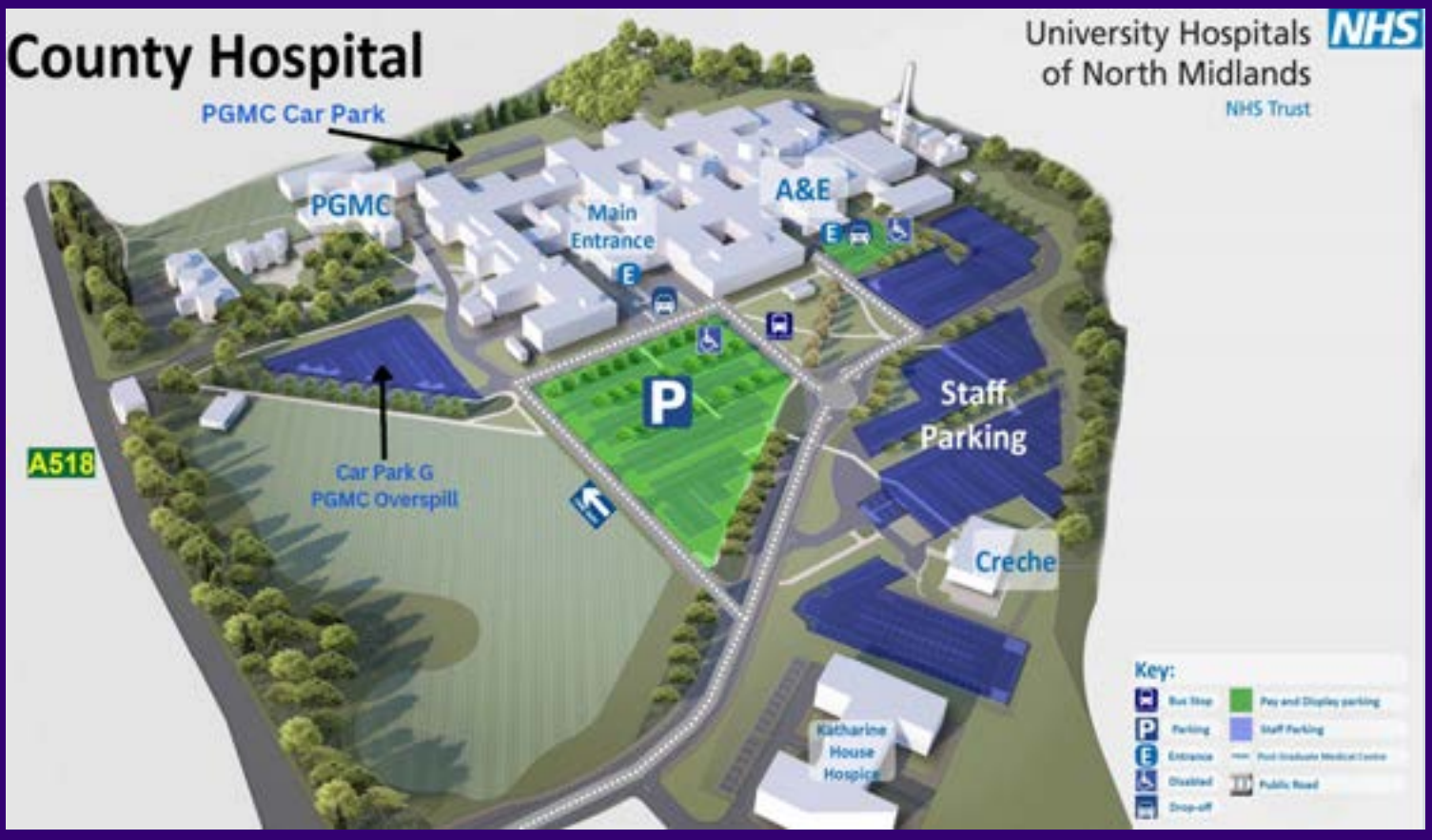

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