Brain Magnetic Resonance Imaging: Perception and Expectations of Neurologists, Neurosurgeons and Psychiatrists

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SUMMARY – *Magnetic resonance imaging (MRI) has rapidly become an essential diagnostic tool in modern medicine. Understanding the objectives, perception and expectations of the different medical specialties towards MRI is therefore important to improve the quality of the examinations. Our aim was to better comprehend the reasons and expectations of neurologists, neurosurgeons and psychiatrists when requesting brain MRI scans for their patients, and also to perceive the degree of confidence of these specialists in the images and respective reports. Sixty-three specialists were recruited from two tertiary hospitals and answered a tailored questionnaire. Neurosurgeons were more concerned with the images themselves; neurologists lacked confidence in both MRI images and reports, and one third of the psychiatrists only read the report and were the most confident of the specialties in MRI findings. These results possibly reflect the idiosyncrasies of each of these medical specialties. This knowledge, driven by efficient communication between neuroradiologists and neurosurgeons, neurologists and psychiatrists, may contribute to improve the quality of MRI examinations and consequently patient care and management of health resources.*

Introduction

Since its development in the 1980s, magnetic resonance imaging (MRI) has revolutionised medical practice and today has a crucial role both in diagnosis and research¹. There are various medical specialties that routinely request MRI studies of the brain for patient care, mostly neurology, neurosurgery and psychiatry. Due to the intrinsic differences among these medical specialties, their perception of several aspects of a conventional MRI study may differ accordingly.

Neurosurgeons typically use MRI for surgical planning and patient follow-up and relatively less for making a diagnosis. Their practice relies heavily on image guidance technology¹. In contrast, neurologists use MRI mainly for diagnostic purposes. Neurologists do not seem to always depend on a neuroradiological

report in order to make clinical decisions². Psychiatrists are not looking for “organic” proof to establish diagnosis, because most psychiatric diseases do not produce lesions visible on routine anatomical MRI³. In addition, differentiation of various psychiatric neuropathologies is rather poor based on MRI findings because few “organic” indicators found in such diseases are frequently shared across a broad range of psychiatric conditions³.

Neuroradiologists should understand the specificities associated with medical practices involving imaging in order to improve the quality of their service and/or shape the clinicians’ perception of the quality of the service. According to Wallis and McCoubrie, the radiological report seems to be the main method of communication between radiologists and clinicians⁴. Hence, neuroradiological reports can be potentially optimised for a specific specialty to im-

prove communication with clinicians and have a greater impact on diagnosis, disease monitoring and treatment⁵. Studies addressing this issue are scarce, although it has been shown that many malpractice cases may derive from poor communication⁴. Radiological reports that do not address the clinician's question, use unfamiliar terms and abbreviations, or include statements out of clinical context stand as the main complaints^{6,7}. Furthermore, only 38% of clinicians read the entire report whereas 43% only read the summary if the report has more than one page⁷. It seems that miscommunication plays an important role in the relation of radiologists and the other specialties.

The purpose of this study was to characterise the perception and expectations of neurosurgeons, neurologists and psychiatrists regarding conventional MRI of the brain.

Materials and Methods

Hospital Centres

Neurologists, neurosurgeons and psychiatrists were recruited from two medical centres, Centro Hospitalar São João (CHSJ) and Centro Hospitalar de Vila Nova de Gaia/Espinho (CHVNG), Portugal. CHSJ and CHVNG are both public tertiary referral hospital centres of two neighbouring cities in the northern region of Portugal. At the time of the study, CHSJ had 1124 beds and an influence area of 3,000,000 inhabitants⁸ and CHVNG had 558 beds and an influence area of 700,000 inhabitants⁹. These centres had all the medical specialties, including neurology, neurosurgery, psychiatry and neuroradiology. CHSJ had seven neuroradiologists and an MRI Unit with two MRI scanners (1.5T and 3T) and CHVNG had four neuro-

radiologists and one MRI scanner (1.5T). Annual records from the year of the present data showed a total of 3293 brain MRIs performed in CHSJ, most of which (60.8%) were requested by neurologists (646), neurosurgeons (1329) and psychiatrists (26). In CHVNG, 1205 brain MRIs were performed, most of which (58.6%) were also requested by these three specialties (430, 268 and eight respectively).

Participants

Sixty-three clinicians from the two hospitals participated in the study: 20 neurologists, 15 neurosurgeons and 28 psychiatrists. Table 1 describes the subject sample. Ethical approval was not obtained because this study is a questionnaire study (descriptive research) and participants are not patients and are able to consent. Informants consented to take part by filling in the questionnaire and handing it to the researcher. Prior to filling in the questionnaire, the informants received information on the study, what participating entailed, told that anonymity was assured and that they had the right to withdraw at any time for any reason.

Instrument

Each participant filled in a tailored questionnaire (Figure 1) addressing the objectives, expectations and use of brain MRI in the subject's professional practice that included open multiple-choice questions and visual horizontal bars (100 mm).

Subjects were instructed to select the best given choice for all questions, and if necessary to use the open field or multiple choices. For visual bars, subjects were instructed to mark an "X" on the scale, proportional to the certainty of the answer. Visual bars were manu-

Table 1 Characteristics of the subject sample.

	<i>CHSJ</i>	<i>CHVNG</i>	<i>TOTAL</i>
<i>Mean age in years (SD)</i>	37 (10.2)	40.5 (10.4)	38.4 (10.4)
<i>Gender</i>			
Male	n=20	n=15	n=35
Female	n=19	n=9	n=28
<i>Neurologists</i>	n=13	n=7	n=20
<i>Neurosurgeons</i>	n=10	n=5	n=15
<i>Psychiatrists</i>	n=16	n=12	n=28

CHSJ – Centro Hospitalar São João

CHVNG – Centro Hospitalar de Vila Nova de Gaia/Espinho

1. Age _____

2. Gender

- Female ☐
- Male ☐

3. Medical Speciality

- Neurology ☐
- Neurosurgery ☐
- Psychiatry ☐
- Other ☐

4. Specialist or resident?

Specialist ☐

Resident ☐

5. In your daily hospital practice, what is the most common reason for requesting a brain magnetic resonance imaging examination?

- To confirm a diagnostic hypothesis ☐
- To exclude another diagnosis ☐
- To follow-up an already known pathology ☐
- To make sure I do not miss anything ☐
- Other(s) _____

6. In your daily hospital practice, what do you usually expect from a magnetic resonance imaging examination?

- To confirm my diagnostic hypothesis ☐
- To suggest another diagnosis ☐
- To present a negative result ☐
- To present a nonspecific result ☐
- To present an unexpected result ☐
- Other(s) _____

7. What is your level of confidence in the quality of images and protocols of brain magnetic resonance imaging examinations?

No confidence
Maximum confidence

8. What is your level of confidence in the quality of the reports of brain magnetic resonance imaging examinations?

No confidence
Maximum confidence

9. How do you usually evaluate the result of a brain magnetic resonance imaging examination?

- I only read the report ☐
- I read both the report and the images ☐
- I only read the images ☐
- Other(s) _____

Thank you for your collaboration!

Figure 1 Questionnaire. Tailored questionnaire applied to the sample of neurologists, neurosurgeons and psychiatrists (translated into English for comprehension).

ally measured at the centre point of the cross in millimetres. Data were anonymised to ensure privacy protection.

Statistical Analyses

Data were processed using SPSS 21.0. Descriptive statistics were used to evaluate the reason for requesting an MRI examination, the expectations regarding the MRI and the assessment of the examination result. One-

way ANOVA with post-hoc analysis using the Tukey test were conducted to compare groups.

Results

Regarding the *most common reason for requesting a brain MRI examination* (Table 2), 95% of the neurologists and 93% of the neurosurgeons answered “to confirm a diagnostic hypothesis”. By contrast, only 39% of the psy-

chiatrists wanted to “to confirm a diagnostic hypothesis”, preferring instead “to exclude another diagnosis” (57%) with brain MRI. Fifty-three per cent of the neurologists also wanted “to exclude another diagnosis”, while neurosurgeons rarely did so (20%). Forty-two per cent of

the neurologists chose additionally “to follow-up an already known pathology”, unlike the neurosurgeons (27%) and psychiatrists (7%). Finally, 16% of the neurologists selected “to make sure I do not miss anything”, compared to only 7% of neurosurgeons and 4% of psychiatrists.

Table 2 Most common reasons for neurologists, neurosurgeons and psychiatrists requesting a brain magnetic resonance imaging scan.

Question	CHSJ			CHVNG			TOTAL		
	Neurologists	Neurosurgeons	Psychiatrists	Neurologists	Neurosurgeons	Psychiatrists	Neurologists	Neurosurgeons	Psychiatrists
“To confirm a diagnostic hypothesis”	100%	90%	31%	83%	100%	50%	95%	93%	39%
“To exclude another diagnosis”	54%	10%	63%	50%	40%	50%	53%	20%	57%
“To follow-up an already known pathology”	46%	10%	0%	33%	60%	17%	42%	27%	7%
“To make sure I do not miss anything”	23%	0%	6%	0%	20%	0%	16%	7%	4%
Other(s)	0%	0%	0%	0%	20%	0%	0%	7%	0%

CHSJ – Centro Hospitalar São João

CHVNG – Centro Hospitalar de Vila Nova de Gaia/Espinho

Table 3 Expectations of neurologists, neurosurgeons and psychiatrists on the result of brain magnetic resonance imaging examinations.

Question	CHSJ			CHVNG			TOTAL		
	Neurologists	Neurosurgeons	Psychiatrists	Neurologists	Neurosurgeons	Psychiatrists	Neurologists	Neurosurgeons	Psychiatrists
“To confirm my diagnostic hypothesis”	85%	100%	63%	100%	100%	92%	90%	100%	75%
“To suggest another diagnosis”	69%	0%	25%	14%	40%	17%	50%	13%	21%
“To present a negative result”	0%	0%	13%	0%	20%	17%	0%	7%	14%
“To present a nonspecific result”	8%	0%	0%	0%	20%	0%	5%	7%	0%
“To present an unexpected result”	8%	0%	0%	0%	20%	0%	5%	7%	0%
Other(s)	8%	0%	6%	0%	0%	0%	5%	0%	3%

CHSJ – Centro Hospitalar São João

CHVNG – Centro Hospitalar de Vila Nova de Gaia/Espinho

Figure 2 Confidence in brain magnetic resonance images, protocols and examination reports. Graphic representations across specialties – Neurology, Neurosurgery and Psychiatry – illustrating confidence in brain magnetic resonance images, protocols and reports.

With respect to the *expectations on brain MRI examinations* (Table 3), all specialties expected to confirm their diagnostic hypothesis (100% of the neurosurgeons, 90% of the neurologists and 75% of the psychiatrists). Fifty per cent of the neurologists, 21% of the psychiatrists and 13% of the neurosurgeons also expected that brain MRI suggested another diagnosis. The only specialties that anticipated brain MRI “to present a negative result” were psychiatry (14%) and neurosurgery (7%). Furthermore, only 5% of the neurologists and 7% of the neurosurgeons selected “to present an unexpected result”, and “to present a nonspecific result”. None of the psychiatrists selected these last two options.

When questioned about their *assessment of the brain scan results*, most of the neurologists (90%) and neurosurgeons (93%) read both the report and the images. Thirty-nine per cent of the psychiatrists and 11% of the neurologists only read the report *but not* the MRI images. Interestingly, no neurosurgeons reported reading only the report, but 7% declared they only read the MRI images. None of the other spe-

cialties, neurology or psychiatry, reported analysing only the images.

Mean *confidence in brain MRI images and protocols* on a 100-point visual bar (Figure 2) was for psychiatrists 81.2 ($SE\ 2.6$) and for neurosurgeons 74.0 ($SE\ 4.5$). Neurologists were the least confident on brain MRI images and protocols (mean rating of 69.9, $SE\ 4.5$).

Considering *confidence in the quality of examination reports* (Figure 2), mean confidence on a 100-point visual bar was 76.7 ($SE\ 3.3$) for psychiatrists, 70.7 ($SE\ 5.6$) for neurosurgeons and 60.5 ($SE\ 5.7$) for neurologists. There were differences between specialties ($F(2, 60) = 3.382, p < .05$). Tukey *post-hoc* showed differences between neurologists and psychiatrists ($p < .05$).

Discussion

We found conceptual and practical differences regarding the use, perception and expectations of brain MRI among neurologists, neurosurgeons and psychiatrists. Neurosurgeons'

most common reason to ask for a brain MRI was to confirm a diagnostic hypothesis, and their main expectation of the examination result was to confirm their initial hypothesis. This was probably because surgeons usually investigate potentially resectable lesions and very often before asking for a brain MRI, particularly in a tertiary hospital, they already know what type of pathology to expect, either because the patient has another image examination and/or was referred by another medical specialty. In addition, due to the interventionist nature of neurosurgery, none of the neurosurgeons only read the report; they need to plan biopsies and surgeries and hence to visualise the pathology and brain anatomy. Neurosurgeons revealed likewise a fairly high confidence in the quality of the images and report, which may be interpreted as how relevant they both are to the neurosurgical diagnosis and intervention. Moreover, because neurosurgical pathology is usually readily visible in MRI scans, there is less space for lack of confidence in images, and error or subjectivity by the neuroradiologist.

Since visualising brain images seems to be fundamental for the neurosurgeons' work, it is important that neuroradiologists assist them in correctly reading the examinations. Structural MRI is more complex than computed tomography, and this may not be readily apparent for the untrained reader.

Psychiatrists also relied on brain MRI scans to confirm their diagnostic hypothesis, but by excluding another diagnosis, most likely due to the "non-organic" nature of the pathology of this specialty. Consequently, out of the three specialties, psychiatry showed the most confidence in the MR images, protocols and reports. One third of the psychiatrists only read the MRI report, hinting either little interest in the images because their pathology is "invisible" or their limited familiarity with this type of examination, at odds with the low number of examinations requested by this speciality. Neuroradiologists should care that psychiatrists are able to read not only the reports but also the images, important for a critical opinion on the quality of the examinations. New challenges await psychiatrists in the near future, with the foreseen growing use of functional magnetic resonance imaging (fMRI), other unconventional MRI techniques and advanced image post-processing in the diagnosis of neurodegenerative and psychiatric diseases^{10,11}.

Neurologists showed the least confidence among the three specialties in MRI images and

reports. This can be explained again by the nature of the pathology investigated by neurologists. Neurological diseases and their differential diagnosis are both numerous and include many rare diseases. Furthermore, neurological examination frequently narrows down the diagnostic list and, most of the time, permits the localisation of the pathology in the central nervous system. On the other hand, diagnosis in neurology can be achieved with other types of examinations, not just brain MRI. In fact, only some of these pathologies are visible in brain scans, while many others give only subtle or subjective imaging signs of their existence, making the work of the neuroradiologist more difficult and less objective. Likewise, clinicians sometimes do not perceive how important detailed clinical information is for the neuroradiologist, both in prescribing the adequate MRI sequences and in evaluating imaging signs.

Understanding the particularities of the different medical practices involving brain imaging may help neuroradiologists improve the quality of their service. Since the examination report is the most important means of communication with other specialties, it should reflect these particularities. Besides the normal effort placed on the clarity and the quality of its content, neuroradiologists should not forget to address the clinician's question in the report, most importantly, as seen before, in the case of the more elusive neurological diseases. The report should also include a reflection on differential diagnosis and the neuroradiologists' uncertainties (when they exist), instead of just affirming or excluding pathology. This could help neurologists increase their confidence in the quality of the neuroradiology work.

Moreover, other communication strategies should be implemented/reinforced, especially in a time of crisis in Europe when the financial aspects of radiology are of most concern. Formal and informal discussion of cases and multidisciplinary meetings and research are of the utmost importance for good communication with clinicians and for better patient care. Additionally, neuroradiology subspecialisation may also be desirable in large hospital centres, for example in fields like paediatric neuroradiology, dementia, movement disorders, and epilepsy, among others.

Good communication between clinicians and radiologists has been shown to have a beneficial diagnostic and therapeutic impact⁵. Some of the great challenges of medical imaging today are to measure accurately the quality of

examinations and the performance of neuroradiologists¹², and to combat examination overutilization¹³.

The limitations of our study concern the type of health institutions investigated and the restricted geographical area. It would be important to replicate this study in other centres and countries in order to validate and generalise our results.

Conclusions

This work sheds light on the motivations of various specialties in requesting brain MRI examinations. We showed that the most common reasons, perception and expectations seem to depend on the particular specialty requesting the scan. Our results illustrate the relevance

of understanding these factors to improve imaging services and communication among the different specialties dedicated to the study of the central nervous system.

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