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Patient Perception of Musculoskeletal MR: a Survey Research

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ABSTRACT

Background: when undergoing magnetic resonance (MR) exams, patients need to lie still in a noisy and enclosed environment for a long time. This condition, together with the anxiety burden related to the possible implications of the scan results, can entail a diagnostic outcome of poor quality.

Objective: the aim of the study was to evaluate the personal perception and experience of adult patients undergoing unenhanced musculoskeletal MR.

Method: consecutive outpatients undergoing unenhanced MR of spine, knee or shoulder were asked to respond a 10-item questionnaire at the end of the exam.

Results: 263 patients (54% males, mean age 50.6 ±15.8 years, range 18-83 years) completed the questionnaire. Patients declared that the most disturbing elements of the exam were forced immobility and noise (30% in both cases). Females perceived significantly higher degree of anxiety than males (56% vs 21%, $p<0.001$). Exam

duration was correctly perceived by 83% of the population. Patients' satisfaction was generally high (mean above 9 over 10).

Conclusion: explanations and clarifications given before the exam were considered satisfactory by the patients. Despite some negative aspects such as noise, immobility and anxiety especially in females, patients' satisfaction with our service was high, as well as the willingness to return.

KEYWORDS

Magnetic Resonance, musculoskeletal, questionnaire, patient perception, anxiety, organization

MAIN TEXT

1. INTRODUCTION

Worldwide, 75 million of Magnetic Resonance (MR) exams are performed each year [1]. The peculiar equipment conformation and the need for the patient to lie still in a noisy and enclosed environment for a long time, together with the anxiety burden related to the possible implications of the scan results, can entail a diagnostic outcome of poor quality.

Many studies on the patients' subjective experience of MR imaging date back to the early years of MR use, when the magnets were less comfortable, the exams' durations longer, and the imaging technique was unknown to the most of people [2-4]. More recently, the international literature focused specifically and mostly on the anxiety generated by MR exams and on the strategies to prevent or alleviate it [5-11]. Some studies (one still ongoing), with quite small numbers, evaluated the MR unit setting taking into consideration subjective patient satisfaction [12-14].

The aim of this prospective study was to evaluate the personal perception and experience of patients undergoing unenhanced musculoskeletal MR, in particular in terms of clarity of information received, discomfort factors of the exam, organization of our outpatient service and willingness to return to the latter in the future, if needed.

2. MATERIALS AND METHODS

2.1 Study population

From January to December 2016, outpatients scheduled to undergo unenhanced MR imaging of the spine, shoulder and knee were asked to respond to a questionnaire

after the exam. Patients were excluded if they were not able to read and understand the Italian language and if they interrupted the exam. Only patients > 18 years old were included.

2.2 MR exams

Before MR, all patients received an information sheet on the general characteristics of the exam.

Exams were performed on a 1.5 Tesla scanner (Philips Achieva, release 3.2, Best, The Netherlands), with the patient in supine position and entering the magnet "head-first" except for the knee exam ("feet-first"). For the cervical spine, a 16-channel phased array coil was used, for the dorsal and lumbar spine a 15-channel coil, and for the shoulder and knee two different 4-channel hard coils.

MR exams were performed with multiplanar Turbo Spin-Echo, Inversion Recovery and Gradient-Echo sequences. Scan times varied slightly according to some factors, among which the number of slices, but the mean exams duration times were 21 minutes for the cervical spine, 16 minutes for the dorsal and the lumbar spine, 23 minutes for the shoulder, 24 minutes for the knee. The bore diameter was standard (70 cm) and forced ventilation was possible along the long axis of the bore. Our scanner was not equipped with any particular tool designed to reduce the noise or other discomforts.

2.3 Questionnaire

The questionnaire was written in Italian and included the following items:

1) Did you undergo MR exams before?
2) Was the information sheet received before the exam clear and explanatory?
3) Who received you in the MR suite (radiographer; nurse; doctor)?
4) Did you clearly understand how to prepare to enter the magnet room (undressing etc.)?
5) How long did the exam take (in minutes)?
6) Which was the most inconvenient aspect of the exam (long duration; noise; forced immobility; discomfort of the body position)?
7) Did this experience generate anxiety in you (the item is scored from 0=none to 4=very much)?
8) Did the organization of the service work (the item is scored from 1=at all to 10=perfectly)?
9) Will you undergo MR in the future, if needed?
10) Will you undergo MR in our service again?

The questionnaire incorporated dichotomous questions (#1, 2, 4, 9 and 10), with a yes/no response, a 5-point Likert scale in question #7, and a 10-point scale similar to a Visual Analog Scale (VAS) in question #8.

2.4 Statistical analysis

Quantitative variables were expressed by means, standard deviations, median, and 25^{th} and 75^{th} percentiles, and analyzed by an independent Student's t-test or Mann-

Whitney U test as appropriate. Qualitative variables were reported by absolute frequencies and percentages and analyzed by Chi-Square test or Fisher's Exact test as appropriate. Spearman rank correlation was performed. Data analysis was performed using STATA/SE for Windows, version 12.1 (StataCorp, college Station, TX, U.S.A.). Statistical significance was defined as $p < 0.05$.

3. RESULTS

In the 12-month study period, 272 patients agreed to complete the questionnaire, however 9 (3.3%) interrupted the exam and were excluded. The final population consisted of 263 subjects (mean age 50.6 ±15.8 years, range 18-83 years),142 males and 121 females (respectively mean age was 49.6 ± 15.6 years and 51.9 ± 16.0years; p=0.2293). The patients' general characteristics are listed in Table 1. Among the 263 exams, only 2 cervical spine MRs were considered of non-diagnostic quality due to motion artifacts.

Table 2 shows the results of the questionnaire in all participants and in males and females. Regarding the aforementioned questions:

1) the answer was "yes" for 170/263 patients (65%), "no" for 89 patients and in 4 cases no answer was given;
2) the answer was "yes" for 257 patients (98%), "no" for 3 patients and in 3 cases no answer was given;
3) the answer was "radiographer" for 185 patients (70%), "nurse" for 39 patients, "doctor" for 29 subjects and in 10 cases no answer was given;

4) the answer was “yes” for 260 patients (99%), “no” for 1 patient and in 2 cases no answer was given;

5) the mean perceived time of examination was 22.8 ± 7.8min. In detail, the answer was “within 20 minutes” for 160 patients (61%), “between 21 and 40 minutes” for 85 subjects, “above 41 minutes” for 7 patients and in 11 cases no answer was given;

6) the most disturbing element of the exam was forced immobility (80 patients, 30%), followed by noise (79 patients), excessive duration (32 patients) and uncomfortable body position (23 patients); 16 subjects did not highlight any inconvenient aspect and 33 patients did not answer (Figure **1**);

7) the degree of anxiety generated by the exam was “0” for 165 subjects (63%), “1” for 46 patients, “2” for 29 subjects, “3” for 14 patients, “4” for 8 patients and 1 subject did not answer (Figure **2**);

8) the organization of our MR service achieved a score of “10” for 180 patients (68%), “9” for 40 patients (15%) and the mean score was above “9”;

9) the answer was “yes” for 254 subjects (97%), “no” for 5 patients and in 4 cases no answer was given;

10) the answer was “yes” for 257 subjects (98%), none answered “no” and in 6 cases no answer was given.

The analysis of the data revealed that as much as 64% of patients were not at the first experience in the MR suite. Among them, only 35% (60 over 170) declared some degree of anxiety, while between subjects at first MR experience the

percentage was nearly 40% (35 over 88 patients); however, the difference between the two groups was not significant (p=0.48).

Patients appreciated the standard information sheet they received before the exam, and understood the oral explanations given by the radiographer in the vast majority of the cases. Most subjects declared that they were received by the radiographer, but 15% and 11% believed to be received by a nurse or a doctor, respectively. Radiographers and nurses have a specific attire with different colors, that are clearly represented on a poster at the hospital entrance. Doctors always wear the white coat.

Exam duration was correctly perceived as below 40 minutes by 83% of the population (mean: 23 ± 8 minutes).

Forced immobility for females and noise for males were the most disturbing elements of the exam. Females experienced significantly more anxiety than males (56% Vs 21%, $p<0.001$). Statistical analysis revealed a weak inverse association between age and anxiety in females ($r = -0.30$, $p < 0.001$), not in males ($r = -0.09$, $p < 0.291$). No association was found between the degree of anxiety and “feet-first” or “head-first” MR exams.

Results of the items 8, 9 and 10 of the questionnaire highlighted the patients’ appreciation for the MR service organization; a weak correlation between age and satisfaction was present in males ($r=0.32$, $p < 0.001$), but not in females ($r=0.02$, $p=0.798$). Except for anxiety, all the other gender differences were not statistically significant.

4. DISCUSSION

The diagnostic value of MR exams can be affected by the disposition of the patient, more than other imaging modalities. This is the reason why we decided to conduct a study to evaluate the personal perception and experience of the patient undergoing unenhanced musculoskeletal MR, and to focus not only on anxiety.

There are five principal findings emerging from this study:

1) patients were satisfied with written and oral explanations and clarifications given before the exam;
2) the rate of non-diagnostic exams was extremely low;
3) forced immobility and noise were the most disturbing elements during the exam;
4) exam-related anxiety was low, however higher in females;
5) patients' satisfaction with our service was high, as well as the willingness to return, if needed.

Giving thorough information about the MR exam before the patient enters the scanner is a crucial issue in limiting fear, anxiety and claustrophobia, as stated by Mohammed et al. in a study on female adolescents [15], in the other works that compared group of patients who received either extended or little/no information [5,6,9,13] and in studies that gave patients different interventions to reduce pre-MRI anxiety (video demonstration, telephone conversation) [16,17]. Even if we did not compare patients with different levels of preprocedural information, we observed that our population appreciated the clarifications given before the exam and reported

a low grade of anxiety during the latter; moreover, the diagnostic quality of the exams was nearly always sufficient for diagnosis. These data again stressed the importance of previous knowledge of the MR procedure, in order to have a positive experience and limit uncomfortable exams of poor diagnostic quality; this was evident in our population also when comparing patients at first MR experience with already experienced subjects. However, we want to recall that not all literature works are in accordance with these conclusions, such as the one by Mackenzie et al. who highlighted that anxiety was not related to patient's understanding of the procedure [3]; moreover, Carlsson et al. concluded that written information did not appear to reduce stress, while interaction with staff did [12].

Our patients declared that the most disturbing elements of the MR exam were forced immobility (30% of patients) and noise (30%). These unpleasant aspects were examined also in other studies, such as the one by Thorp et al., who found that immobility disturbed nearly the 29% of the study population and noise the 19% [2], and the one of Danterdorfer et al. who concluded that noise and narrowness were the most disturbing factors in a 1.5 Tesla scanner [4].

The finding that anxiety was significantly higher in females was in accordance with the previous literature regarding the general population (lifetime prevalence of anxiety disorders is 60% higher in women [18]), and also when related specifically to radiological procedures [6,11].

Another interesting data coming from our population was that more than 80% of patients correctly estimated exam duration, within 40 minutes. At present, we were

not able to find any previous study on this specific topic, even if many efforts are made by researches and MR devices vendors to shorten acquisition times while maintaining a proper diagnostic quality. This could be a cue to further investigate the theme by implementing experimental studies.

The organization of our MR outpatient service satisfied our study population, that expressed the willingness to return to the latter in the future, if needed. This result is in line with the one by Munn et al. who registered a mean of nearly 9 over 10 in a satisfaction VAS similar to ours in item #8 [12].

The study suffered from many limitations. Among them, this is a single-center study and population was relatively small, in particular when considering how commonly unenhanced musculoskeletal MR is performed, however we have a small MR service and a significant number of subjects declined to answer the questionnaire. The population could not be considered as representative of the general population that undergoes MR, but we decided to focus our attention to a "standard" procedure of unenhanced musculoskeletal MR to limit confounding factors. Moreover, the questionnaire was not a standardized method to evaluate the personal perception and experience of the subject undergoing MR, but was conceived and built to meet the specific need to understand our patients' experience; in addition, it was not validated, used before and piloted. As also stated before, we did not compare patients with different levels of preprocedural information, so we could not gather specific information on the topic. We did not ask patients about their anxiety status before the procedure, but only after MR; this was decided in order not to overwhelm

the subjects and also because anxiety evaluation was not the only concern in our study. Another limitation was that probably a performance bias was generated by the MR staff members, because of the awareness that patients were asked to fill a questionnaire. A bias could be also generated because the questionnaire did not contain open questions, and thus it did not allow patients to elaborate on their experience, but this was decided in order to keep it simple and easy to answer. Finally, we decided to exclude the patients that did not terminate the exam (3% of the ones that gave consent), even if we were aware that this could represent a selection bias.

5. CONCLUSION

In conclusion, we were able to give satisfactory information on unenhanced musculoskeletal MR and to clearly explain to the patient population how to prepare for the exam in the vast majority of cases. The diagnostic quality of exams was sufficient for diagnosis in most cases. Even if a low degree of anxiety was generated by the exams, females were significantly more affected than males and a fair number of patients reported that noise and forced immobility were disturbing elements. Patients appreciated the organization of our MR service.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This prospective observational study was approved by the institutional ethics committee of the Azienda USL di Piacenza, Italy (protocol SURVEY MR, n.

1557/2015), and was carried out in accordance with the Declaration of Helsinki for experiments involving human subjects.

Before MR, all patients gave written informed consent.

CONFLICT OF INTEREST

Chandra Bortolotto is a consultant for Bracco Imaging and Doc Congress.

Fabrizio Calliada is a consultant for Bracco Imaging Italia, Hitachi Medical System Europe, Shenzhen Mindray Bio-Medical. The other authors declare that they have no declarations of interest.

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TABLES

Table **1.** Patients' characteristics and types of MR exams.

	All	Males	Females
n (%)	263 (100)	142 (54)	121 (46)
Age - mean ± SD	50.6 ± 15.8	49.6 ± 1.3	51.9 ± 1.5
MR-type - n (%)			
Lumbar spine	123 (46.8)	71 (50.0)	52 (43.0)
Knee	62 (23.6)	34 (23.9)	28 (23.1)
Cervical spine	48 (18.2)	21 (14.8)	27 (22.3)
Shoulder	26 (9.9)	16 (11.3)	10 (8.3)
Dorsal spine	4 (1.5)	0 (0.0)	4 (3.3)

Table **2.** Questionnaire responses, in all patients and by gender.

	All	Females	Males	p-value
	263	121 (46)	142 (54)	
Have you ever undergone an MR exam before? n (%)				
Yes	170 (64.6)	77 (63.6)	93 (65.5)	
No	89 (33.8)	43 (35.5)	46 (32.4)	0.643
No answer	4 (1.5)	1 (0.8)	3 (2.1)	
Was the information sheet clear? n (%)				
Yes	257 (97.8)	120 (99.2)	137 (96.5)	
No	3 (1.1)	1 (0.8)	2 (1.4)	0.552[#]
No answer	3 (1.1)	-	3 (2.1)	
Who received you when entering the MR suite? n (%)				
Radiographer	185 (70.3)	87 (71.9)	98 (69.0)	
Nurse	39 (14.8)	19 (15.7)	20 (14.1)	0.951
Doctor	29 (11.0)	13 (10.7)	16 (11.3)	
No answer	10 (3.8)	2 (1.7)	8 (5.6)	
Did you clearly understand how to prepare before entering the magnet room? n (%)				
Yes	260 (98.9)	120 (99.2)	140 (98.6)	

No	1 (0.4)	-	1 (0.7)	0.540#
No answer	2 (0.8)	1 (0.8)	1 (0.7)	
How long did the exam took? (minutes)				
Media ± SD	22.8 ± 7.8	23.5 ± 8.2	22.2 ± 7.4	0.203##
Which was the most inconvenient aspect of the exam? n(%)				
Immobility	80 (30.4)	45 (37.2)	35 (24.7)	
Noise	79 (30.0)	32 (26.5)	47 (33.1)	
Duration	32 (12.2)	16 (13.2)	16 (11.3)	0.256
Position	23 (8.8)	9 (7.4)	14 (9.9)	
None	16 (6.1)	6 (5.0)	10 (7.0)	
No answer	33 (12.6)	13 (10.1)	20 (14.1)	
Did this experience generate anxiety? (rank on a scale 0-4) - n (%)				
0 (at all)	165 (62.7)	53 (43.8)	112 (79.4)	
1 (moderately)	46 (17.5)	25(20.7)	21 (14.9)	
2 (medium)	29 (11.0)	26 (21.5)	3 (2.1)	<0.001#
3 (much)	14 (5.3)	10 (8.3)	4 (2.8)	
4 (very much)	8 (3.0)	7 (5.8)	1 (0.7)	
No answer	1 (0.4)	-	1 (0.7)	
Was the service organization good? (1-10 scale: 1= at all, 10=perfect)				
25^{th},50^{th},75^{th} percentiles	9, 10, 10	9, 10, 10	9, 10, 10	
Will you undergo MR in the future? n (%)				
Yes	254 (96.6)	115 (95.0)	139 (97.9)	
No	5 (1.9)	5 (4.1)	-	0.020#
No answer	4 (1.5)	1 (1.08)	3 (2.1)	
Will you undergo MR in our service? n (%)				
Yes	257 (97.7)	119 (98.3)	138 (97.2)	
No	-	-	-	
No answer	6 (2.3)	2 (1.7)	4 (2.8)	

Fisher's exact test

Mann Whitney U-test

FIGURES

Fig. **1**. Most inconvenient aspects of the exam within males and females (p=0.256), and all patients.

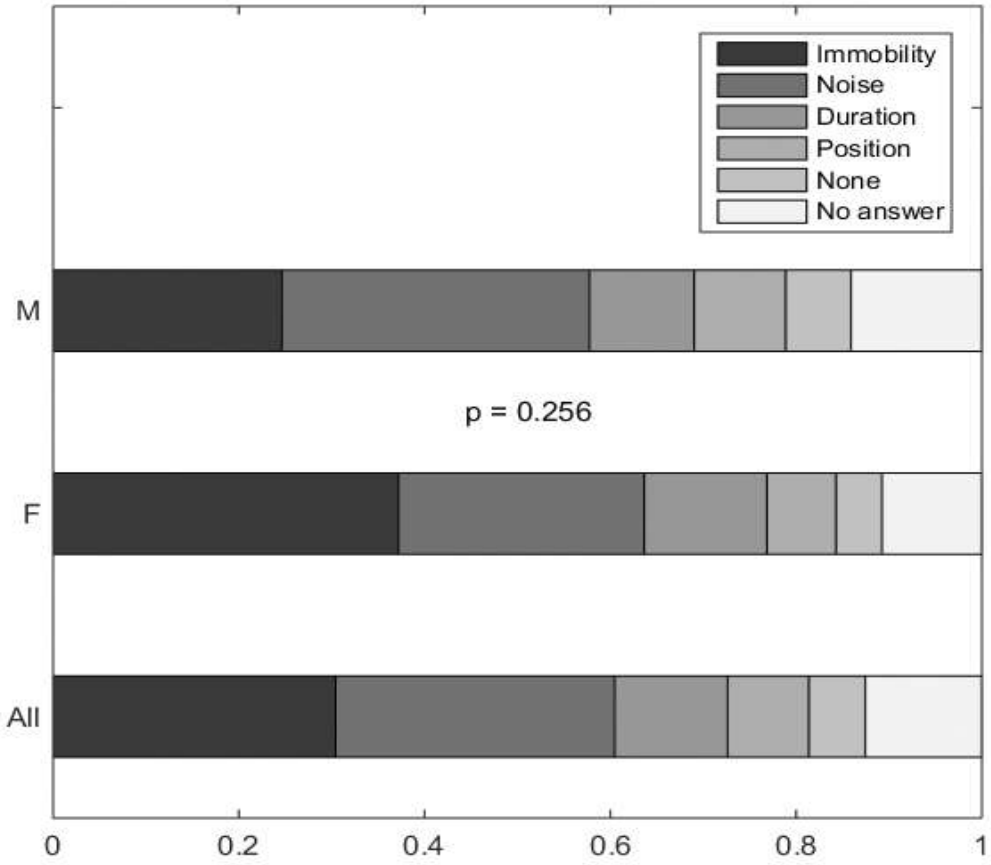

Fig. **2**. Anxiety levels in males and females ($p<0.001$), and all patients (scale from 0=none to 4=very much).