Claustrophobia during Magnetic Resonance Imaging (MRI): Cohort of 8 Years

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Authors' contributions

This work was carried out in collaboration between three authors. Author FM designed the study and wrote the protocol. Author KB preformed the statistical analysis, author FM managed the literature search and wrote the first draft of the manuscript with assistance from author SSMA. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Objective: To calculate rate of claustrophobia in our population with further stratification.
Materials and Methods: This study was conducted in Aga Khan University Hospital (AKUH) Karachi. All patients undergoing Magnetic Resonance Imaging (MRI) for various indications, from 1st January 2006 to 31st December 2013 were enrolled. All cancelled MRI exams were retrieved from Radiology Information System (RIS) and rate of claustrophobia was calculated from total requested patients and separately from all cancelled exams. The MRI exams were performed on 1.5 and 3 Tesla machines. Claustrophobia rate was further analyzed in subgroups on the basis of age, gender, techniques, timings and body area covered and Odds ratios were calculated.
Results: In eight years, 76,254 patients underwent MRI exams. Out of total scans performed, 417 patients were found to be claustrophobic with rate of 0.53% making 14.32% of total cancelled exams due to various reasons.
Conclusion: Though claustrophobia rate is acceptable in our set up, it contributes to a significant proportion in all cancelled exams.

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1. INTRODUCTION

Magnetic Resonance Imaging (MRI) has been described as the most important medical revolution in the last 25 years [1]. It is found that 1- 15% of all the patients suffer from claustrophobia, during an MRI examination and therefore cannot be scanned or require adequate sedation to undertake the examination. (Mean 2.3%; 95% confidence interval [CI], 2.0–2.5%) [2]. Claustrophobic patients are scared and find themselves in a state of detainment [3]. Use of Minor tranquilizers in these patients becomes necessary for completing the study or to acquire additional sequences. This situation hinders workflow, reduces patient compliance and wastes valuable scanning time. Therefore, reduction of noise and use of short bore scanners are essential in decreasing the rate of claustrophobic reactions [2].

Thus, we have performed an audit study to evaluate claustrophobia rate.

2. MATERIALS AND METHODS

2.1 Study Design

The study was conducted in the Radiology department of Aga Khan University Hospital Karachi with 1.5T and technically advanced 3T scanners. The data were collected retrospectively from 1st January 2006 to 31st December 2013 using RIS software version 1.0.0. All patients who came for scanning were included. Patients were considered claustrophobic if had panic attack, felt anxious, detained or frightened. Other causes of cancellations like seizures, restlessness or unconsciousness were recorded. Patients below five years of age were also excluded. All parameters like dressing rooms, waiting rooms and staff were constant during entire study period. Hearing protection was used in all patients. The study obtained ethical approval from university ethic review committee.

2.2 Data Analysis

Claustrophobia rate was calculated in all patients as well as in total cancelled exams. We further performed inter factorial comparisons of the rate of claustrophobia among patients according to age, gender, body area covered, technique of exam (head first/feet first) and time of scan.

Adjusted Odds ratio and confidence intervals were obtained. Statistical analysis was performed on Microsoft EXCEL 2010 and Confidence interval analysis on WINDOWS 2.12. p values of 0.05 or less were considered statistically significant.

3. RESULTS

In eight years, 76,254 patients underwent MRI, 471(0.53%) were found to be claustrophobic making 14.32% of total cancelled exams. Then out of total patients we calculated Adjusted Odds ratio and confidence intervals in following subsets to understand the distribution as shown in Table 1.

Table 1. Claustrophobia rate in MRI examination: Odds ratio and 95% confidence interval for various outcomes

Characteristics	Adjusted OR	95% CI
Middle age vs. all other ages	2.17	2.07-2.27
Women vs. men	1	0.9-1.1
Head-first vs. feet-first MR examinations	1.95	1.85-2.05
Mornings vs. evening timings of examinations	1.28	1.20-1.36
Adults vs. pediatrics	4.39	4.2-4.5
Head and neck vs. all other body regions	0.99	0.92-1.06

These results show claustrophobia is more common in middle age adult group, in females, in head first exams, in morning shifts and in head and neck scans (Table 2).

For age distribution we divided patients in two groups ,less than 15 years (pediatric group) and greater than 15 years(adult group) making (9/6741) 0.13% and (408/69513) 0.58% respectively in their age group.

For gender distribution our results were, females (230/41341) 0.6%, males (187/34913) 0.5% respectively.

For body area scanned maximum number of scans were performed for head and neck with results of (195/34021) 0.6%.

Table 2. Rate of claustrophobia in subgroups of patients with P-value (N 76254)*

Characteristics	N/N	Percentage (N/N)	P-value
Age set			< 0.001
Below 40 years	91/31477	0.3% (0.2 - 0.4)	
40 to 65 years	253/31632	0.8% (0.7 - 0.9)	
Above 65 years	73/13145	0.6% (0.5 - 0.7)	
Age group			
Adults	408/69513	0.5% (0.45 - 0.55)	< 0.001
Paediatrics	9/6741	1.3% (1.0 - 1.5)	
Gender			< 0.001
Female	230/41341	0.6% (0.5 - 0.7)	
male	187/34913	0.5% (0.4 - 0.6)	
Time of MR examination			< 0.001
Afternoons	127/27435	0.5% (0.4 - 0.6)	
Mornings	290/48819	0.6% (0.5 - 0.7)	
Scanning direction			< 0.001
Head-first MR examinations	407/72754	0.6% (0.5 - 0.7)	
Feet-first MR examinations	10/3500	0.3% (0.1 - 0.5)	
Region of MR examination			< 0.001
Head and neck	195/34021	0.6% (0.52 - 0.68)	
Spine	142/33564	0.4 (0.33 - 0.47)	
Extrimity	22/4688	0.5% (0.3 - 0.7)	
Abdomen	42/1423	3.0% (2.1 - 3.9)	
Breast	4/60	8.3% (1.3 - 15.2)	
Pelvis	12/2498	0.5% (0.2 - 0.8)	

For scanning direction, Head-first MR examinations were maximum and (407/72754)0.6%.

For timings of exams it was more common in morning shifts (290/48819)0.6%.

All of these results have p-value of < 0.001 signifying the results.

4. DISCUSSION

Claustrophobic reactions are a major hindrance to performing MR examinations.

A claustrophobic rate of 0.54% was found in a study on 3324 Malaysian patients examined with a conventional MR scanner which is comparable with the results of Dewey et al. [4] in 12,736 patients examined with the recent short-bore MR scanner (0.7). Higher socioeconomic status and education, middle age and male gender were the important risk factors identified in this study, for the development of claustrophobia. The authors' hypothesis that such low claustrophobia rates in their study, compared with those conducted in Western Europe and North America is due to low level education in their target population. Cultural and geographical differences may also play a role in variability of rate. In contrast to another cohort study on 55,000 patients, we found that men were more likely to suffer claustrophobic reaction during MRI than women, whereas risk factors including middle age and head first examination were equivalent. Patients with claustrophobic anxiety, are likely to experience claustrophobia in up to 35% of all MRI examinations [5]. These patients require conscious sedation or additional sequence after sedation for complete scan. This scenario involves significant risks of negative events for example oxygen desaturation [6] and is associated with added costs, since it delays function, limits patient compliance, and wastes valuable scanning time. Moreover, early termination of scan results in significant financial loss to health care organization.

Claustrophobic reactions can be avoided during MR imaging by mainly reducing noise and sensation of confinement [7].

A more patient-centered design of closed MR systems is one practical approach to make MR imaging more comfortable for patients. Few studies have compared recent closed MR scanners with noise reduction and short wide

bore design with conventional MR scanners to assess patients' content and comfort level and researched on potential ways to reduce claustrophobic reaction.

Recent 1.5-T MR scanner with 97% noise reduction and a short- and wide-bore design was assessed by Dewey et al. [2] in a large cohort study of 55,734 outpatients, which showed reduction in claustrophobia by a factor of 3. Patients were examined on either the recent or a conventional MR scanner. Intra individual comparisons of patients who also showed similar results with a claustrophobia rate of below 1% [2].

In another retrospective study on the occurrence of claustrophobia in 5,682 patients, Dantendorfer et al. [8] found no significant difference between either a 1.5-T closed MR scanner or a 0.5-T noise-reduced MR scanner with a short and wide bore. However, the authors concluded that short bore scanners may reduce claustrophobia, considering there was selection bias in their study; as very anxious patients were referred to recent scanners by the staff [8]. Later study conducted by Dantendorfer et al. [9] on 297 patients without prior MR imaging experience, the authors concluded that there was no significant correlation between motion artifact and pre scan anxiety assessed with STAI score. Moreover there was no difference in patients' acceptance of two MR units(1.5-T closed MR scanner or a recent 0.5-T noise-reduced MR scanner with a short and wide bore). Motion artifact was mainly related to patients concern about the technical apparatus in general. Concerns about improving patients' acceptance of MR imaging led to introduction of a more open vertical scanner configuration, however, they had poor image quality due to low field strength (0.2T). Bangard et al. [10] in his pilot study tested 36 claustrophobic and 36 non-claustrophobic patients on a high field strength (1.0 T) open MR scanner. Validated questionnaires i.e. State-Trait Anxiety Inventory, Claustrophobia Questionnaire, MRI Fear Survey Schedule (STAI, CLQ, MRI FSS) were utilized to assess anxiety among patients in both groups. Scan termination rate among claustrophobic patients was reduced to 8% compared to 58.3% in previous examinations on conventional MR systems, and open MR scanner was preferred by 91.7% of the subjects. In addition, no relation was found between claustrophobia and motion artifacts. A 0.5-T interventional MR scanner with a vertical gap in the bore of the magnet ("double donut") was

utilized by Spouse et al. [11] in his study. He reported that 96% of 50 claustrophobic patients, whose scans were terminated on conventional MR scanner due to anxiety, were able to complete imaging on Interventional scanner. Nonetheless, friends or relatives were allowed to accompany in the magnet room and most patients felt that this, beside the scanner design, had helped them considerably [11].

A randomized controlled CLAUSTRO trial by Judith et al, directly compared an open MR scanner with a vertical 1.0-T magnetic field, and a closed noise-reduced MR scanner with a short- and wide-bore design and 1.5-T field strength in regards to claustrophobia, image quality and influence on further clinical management. They found a positive trend for open MR imaging. Despite, there was a 25% claustrophobia rate for both scanners. Hence, more patient-centered MR configurations should be designed [12,13].

In contrast, our study of 76,254 patients, undergoing MRI examination with a conventional 1.5 MR scanner and a technologically advanced 3 T MR scanner, we found very low claustrophobia rate of 0.53%, with far more occurrence in head first examination, females, middle age group, and morning appointments. This can be explained by low socioeconomic and education status of our general population.

Comparison of claustrophobia rate in our population with other published cohorts is given in (Table 3).

4.1 Study Limitations

Our study is left out with some factors that may correlate to claustrophobia including, level of education, socioeconomic status and surgical history; hence it was difficult to assess these factors on retrospective data. Similarly characteristics such as patient weight and height were not available in electronic data. Moreover, we had no information regarding the nature of the scan such as pre or post-operative, which can also contribute to the anxiety level of the patient and may affect the claustrophobia rate. Record of these factors can improve design of future prospective studies.

Role of nursing staff, radiographers and physicians in providing moral support and good customer care, plays a vital role in comforting anxious patients and therefore this aspect also needs to be assessed as a variable [14].

Table 3. Rate of claustrophobia in previous clinical MR imaging studies and the present study[*]

Study	Year	Number of patients	Claustrophobia
Weinreb et al. [15]	1984	450	3 (0.7%)
Hricakand Amparo [16]	1984	1160	31 (2.7%)
Brennan et al. [5]	1988	52	4 (7.7%)
Flaherty and Hoskinson [17]	1989	210	9 (4.3%)
Avrahami [18]	1990	3000	46 (1.5%)
Kilbornand Labbe [19]	1990	108	7 (6.5%)
Dantendorfer et al. [8]	1991	5682	50 (0.9%)
MacKenzie et al. [20]	1995	500	5 (1.0%)
Murphy and Brunberg [21]	1997	939	134 (14.3%)
Sarji et al. [4]	1998	3324	18 (0.5%)
Francis and Pennell [22]	2000	1754	74 (4.2%)
Kaltenthaler et al. [23]	2004	782	24 (3.1%)
All previous studies[b]		17,961	405 (**2.3%**)
Present study (conventional MR)	2013	76,254	417 (0.53%)

5. CONCLUSION

Claustrophobia rate is acceptable in our set up, however, it contributes to a significant proportion in all canceled exams.

Our claustrophobia rate is 0.53%, making 14.32% of total cancelled exams. It is more common in middle age group, females, head first exams, morning appointments and in head and neck scans.

CONSENT

Not applicable due to retrospective nature of the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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