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Scientific Article

On Patient Experience and Anxiety During Treatment With Magnetic Resonance–Guided Radiation Therapy

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Purpose: To assess patient experience and anxiety during magnetic resonance (MR)–guided radiation therapy (MRgRT) using a hybrid 1.5Tesla (T) MR-guided linear accelerator (MR-Linac) when offered calming video content.

Methods and Materials: A single-center study was conducted within the Multi-Outcome Evaluation of Radiation Therapy Using the MR-Linac (MOMENTUM) cohort. Patients were offered to watch calming video content on a video monitor during treatment. Questionnaires were used to assess patient experience (MR-Linac patient-reported experience) and anxiety (State-Trait Anxiety Inventory, STAI) at first treatment fraction (M1) and at third, fourth, or fifth treatment fraction (M2). Paired *t* tests were used to test for significant differences, and effect sizes (ESs) were used to estimate the magnitude of the difference.

Results: Between November 2021 and November 2022, 66 patients were included. The majority were men (n = 59, 89%). MRgRT was most frequently delivered to prostate cancer (n = 45, 68%) followed by a lesion in the pancreas (n = 8, 12%). At M1 and M2, 24 of 59 patients (41%) preferred to watch calming video content. One patient was not able to look at the video monitor comfortably at M1. Patient experience was generally favorable or neutral; tingling sensations were reported by 17% of patients. Anxiety levels were high (16%), moderate (18%), or low to none (67%) prior to M1. STAI scores were 33 (SD, 9) prior to M1 and 29 (SD, 7) after M1 (ES, 0.7; $P < .001$). STAI scores were 32 (SD, 9) prior to M2 and 31 (SD, 8) after M2 (ES, 0.4; $P = .009$).

Conclusions: Patients were able to comfortably view the video monitor during MRgRT. Consequently, this setup could be used for future applications, such as biofeedback. A sizable minority of patients preferred to watch calming videos that distracted them during treatment. Although the patients' experience was overall excellent, anxiety was reported. Anxiety levels were highest prior to treatment and decreased after treatment.

Introduction

Magnetic resonance (MR)–guided radiation therapy (MRgRT) is increasingly being applied in the treatment of patients with cancer.[1,2] The diagnostic quality of soft-tissue contrast facilitates more detailed visualization of anatomy. In combination with the daily adaptive

Sources of support: Research agreement with Elekta with in-kind provision of the in-room monitor.

Data sharing statement: Individual deidentified participant data will be made available upon reasonable request to the corresponding author.

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workflow, delineations can be adjusted to match the anatomy of the day. However, magnetic resonance imaging (MRI) produces noise and heat, and the treatment takes place in a confined bore. The acquisition of MRI and adaptation of delineations increase treatment time to >40 minutes,[3] all of which could impede patient experience.

Literature shows that noise and heat are not impacting patient experience largely.[4-6] Conflicting results were found regarding the patients' experience of calmness during MRgRT. The proportions of patients who did not feel calm during treatment ranged from 4% found by de Mol van Otterloo et al[7] to 21% found by Barnes et al.[4] Anxiety was not directly assessed in these studies. Sayan et al[5] included a question to assess anxiety after MRgRT. After their first treatment fraction (M1), 45% of patients reported some degree of anxiety.

Several calming, nonpharmaceutical interventions could distract patients during MRgRT. A benefit of (audio) visual systems on patient comfort and anxiety was previously suggested in radiology.[8-10] However, this effect has not been studied during MRgRT before. With the rise of gating with visual breathing feedback, in-room video monitors will become increasingly available.[11,12] When patients are not treated with gating, or when gating requires no biofeedback, such as with exception gating procedures, an opportunity arises to use the video monitor for calming content. We hypothesized that calming video content would improve patient experience.

The primary aim of this study was to assess whether it was feasible for patients to look at a video monitor during MRgRT and whether patients prefer to look at calming video content. Additionally, the study aimed to assess the levels of anxiety experienced by patients throughout the course of MRgRT treatment.

Methods and Materials

Study population

Patients were prospectively enrolled from the ongoing cohort study Multi-Outcome Evaluation of Radiation Therapy Using the MR-Linac (MOMENTUM)[13] in the University Medical Center (UMC) Utrecht between November 2021 and November 2022. Eligible patients for the MOMENTUM study were >18 years of age and received radiation therapy on a 1.5 Tesla (T) MR-guided linear accelerator (MR-Linac) (Elekta AB, Stockholm, Sweden). For this study, patients were included when they signed informed consent and agreed to answer questionnaires. The MOMENTUM study and this substudy received approval from our institutional review board.

Study outcomes

Outcomes of interest were patient experience and anxiety. Patient experience was assessed using the MR-Linac patient-reported experience questionnaire. This questionnaire was created and validated by Barnes et al,[4] and was previously translated to Dutch and piloted.[7] A group of representative Dutch patients provided feedback, from which an additional "neutral" response option was added. All statements were answered on a 5-point Likert scale ranging from "totally disagree" to "totally agree." For this study, the study team added 5 questions on the experience with the video monitor, including statements and open questions (Table E1). Anxiety was measured by means of the State-Trait and Anxiety Inventory (STAI)-State Y1.[14] The 20 statements of this questionnaire are rated on a 4-point Likert scale ranging from "not at all" to "very much so." STAI scores were scored on a scale from 20 to 80 and classified as no or low anxiety (20-37), moderate anxiety (38-44), and high anxiety (45-80).[15] Heart rate was measured to establish feasibility of measuring heart rate in the MR-Linac environment and to explore whether it could be a marker for anxiety. Heart rate was continuously measured when patients were positioned on the treatment table. An MRI-conditional pulse oximeter (7500FO, NONIN Medical Inc) was used. Assessments took place at first treamtent fraction (M1), and third, fourth, or fifth treatment fraction (M2). The STAI-State Y1 was assessed directly prior to and after M1 and M2. The MR-Linac patient-reported experience was assessed directly after M1 and M2. The pulse oximeter measured heart rate during M1 and M2.

Study setup

A MR-safe video monitor (BOLDscreen 32, Cambridge Research Systems Ltd) was installed at the end of the bore of a 1.5 T Unity MR-Linac. The pulse oximeter was positioned outside the 200 Gauss line, with a fiber optic sensor connected to the patient's fingertip. All patients were asked whether they preferred the monitor to be on during M1 and M2. When they did, they were positioned with MR-safe prismatic glasses or a mirror above their head to view the video monitor. The video content was adapted from Philips ambient experience, and patients had the option to choose from 5 themes, such as nature or lakes. MR-compatible prescription glasses were available and compatible with the present setup. The treatment plan was in accordance with local standard practices.

Data analysis

Categorical data were summarized using frequencies with percentages. Numerical data were summarized using either mean with SD for normally distributed data or median with IQR for skewed data. Paired t tests were performed to determine significance ($P < .05$) of differences in anxiety. When patients only answered 1 of the

questionnaires of the paired analyses, they were excluded from the paired *t* test. Since there is no available literature on minimal important differences of the STAI score, effect sizes (ESs) were used to estimate meaningful differences. Cohen's *d* approach was used to calculate ES.[16] An ES of 0.2 was defined as a small effect, an ES of 0.5 as a medium effect, and 0.8 as a large effect. Baseline characteristics were stratified for patients with no or low anxiety, and moderate or high anxiety. For heart rate, the mean and SD were determined based on the first 10 minutes of treatment to align the duration of measurement for every patient, irrespective of their total treatment time. Analysis of variance was used to test for differences in heart rate measurement for each category of anxiety. All analyses were performed in Statistical Package for the Social Sciences (SPSS, IBM) version 25.

Results

Study population

Of the 79 eligible patients treated on MR-Linac during the study period, 66 (84%) patients were included (Fig. 1). Twelve were not enrolled due to logistical problems and one patient was excluded due to downtime of the MR-Linac. All patients were treated according to standard fractionation schedules. Delayed daily treatment schedules caused patients to not be invited to answer questionnaires. At M1, 59 patients were invited to answer questionnaires. Fifty-two (88%) patients responded prior to treatment, and 53 (90%) to 54 (92%) patients responded after treatment. At M2, 60 patients were invited to answer questionnaires. Fifty-six (93%) patients responded prior to treatment, and 52 (87%) to 55 (92%) responded after treatment.

Of the included patients, 89% (n = 59) were male (Table 1). Treatment was most frequently delivered to the prostate (n = 45, 68%), followed by pancreas (n = 8, 12%) and lymph node oligometastasis (n = 7, 11%). Five fractions were prescribed in 67% of patients (n = 44). The average treatment time was 39 minutes (SD, 16) for M1 and 35 minutes (SD, 14) for M2. All treatments were delivered as planned.

Nonresponding patients were more frequently treated for prostate cancer (M1, 75% vs 67%; M2, 73% vs 67%) and had shorter treatment time at M1 (34 vs 40 minutes) (Table E2).

Patient experience

Regarding emotional coping, 50 of 54 patients felt calm during treatment, 2 of 54 patients needed to force themselves to manage the situation, and 1 of 54 patients wanted to come out of the machine during treatment (Fig. 2). Regarding the treatment environment, all patients found the lighting (52/52) and the noise (54/54) in the room easy to tolerate and 3 of 53 felt (too) hot during treatment. Two of 53 patients did not find the treatment bed comfortable and 2 of 54 did not find the treatment position comfortable. Regarding physical complaints, 1 of 53 patient experienced a metallic taste during treatment, 3 of 53 experienced dizziness during treatment, 3 of 54 experienced dizziness after treatment, and 9 of 54 experienced tingling sensations during treatment. Results of

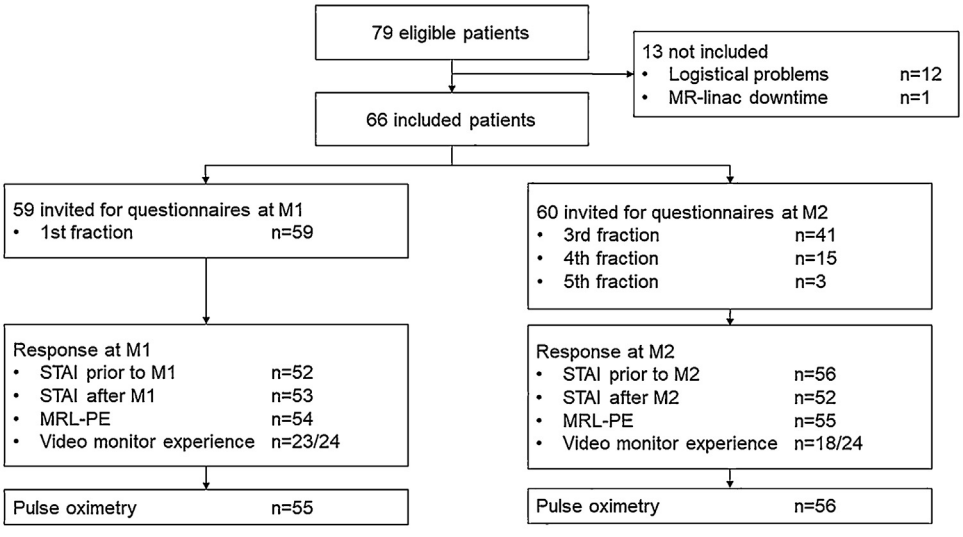

Figure 1 Flowchart of included patients.
Abbreviations: M1 = first treatment fraction; M2 = third, fourth, or fifth treatment fraction; MR = magnetic resonance; MRL-PE = magnetic resonance linear accelerator, MR-Linac = magnetic resonance guided linear accelerator, patient-reported experience; STAI = State-Trait and Anxiety Inventory.

Table 1 Baseline characteristics of the study population

Characteristic	Values (n = 66)
Age (y), median (range)	73 (54-82)
Sex, n (%)	-
Male	59 (89)
Female	7 (11)
ECOG/KPSS performance score, n (%)	-
0/90-100	23 (35)
1/70-80	9 (14)
Unknown	34 (52)
Tumor site, n (%)	-
Prostate	45 (68)
Pancreas	8 (12)
Lymph node	7 (11)
Rectum	4 (6)
Other	2 (3)
Treatment time (min), mean (SD)	-
M1	39 (16)
M2	35 (14)
Number of fractions, n (%)	-
3	3 (5)
5	44 (67)
6	3 (5)
20	16 (24)
Prescribed medication, n (%)	-
Cardiac*	9 (14)
Calming†	5 (8)
Concurrent therapy, n (%)	-
Chemotherapy	1 (2)
Hormone therapy	14 (21)

Abbreviations: ECOG = Eastern Cooperative Oncology Group; KPSS = Karnofsky Performance Status Scale; M1 = first treatment fraction; M2 = third, fourth, or fifth treatment fraction.
*Includes beta-blockers and calcium antagonists.
†Includes benzodiazepines and antidepressants.

patient experience at M2 were generally similar, apart from whether patients wanted to come out of the machine during treatment (Fig. E1). At M2, 5 of 55 patients wanted to come out of the machine during treatment.

Video monitor experience

At measurement M1, 24 of 59 patients (41%) preferred to use the screen. At measurement M2, 24 of 59 patients (41%) preferred to use the screen. Fifteen patients (26%) preferred to use the screen during both M1 and M2 measurements, whereas for the other patients, the screen was on during 1 of the 2 measurements. Three patients who only preferred to use the screen during M1 were retrospectively contacted, and they all explained that the music was calming enough, and there was no need for additional distraction with a video monitor. In neither of these cases, it was due to an uncomfortable position. To the statement that they could look at the video monitor comfortably, 1 patient (5%) at M1 and none at M2 disagreed (Fig. 3). To the statement that the video monitor helped during treatment, 2 patients (8%) at M1 and 3 patients (11%) at M2 disagreed. In free text, stated advantages of the video monitor were "distracting," "relaxing," "nice," "makes the bore feel more spacious," and "nice images." Stated disadvantages were "did not work for me," "boring content," "could not see the video monitor fully," and "difficult without glasses."

Anxiety

Prior to M1, high anxiety (score, 45-80) was reported by 16% (n = 8), moderate anxiety (score, 38-44) by 18% (n = 9), and low or no anxiety (score, 20-37) by 67% (n = 35) of patients (Fig. 4). After M1, high anxiety was reported by 2% (n = 1) and moderate anxiety by 13% (n = 7) of patients. A significant decrease in STAI score from 33 (SD, 9) prior to M1 to 29 (SD, 7) after M1 was noted (ES, 0.7; $P \leq .001$; Table E3). The mean STAI score prior to M1 was 38 (SD, 10) for patients who chose to view calming video content and 32 (SD, 8) for patients who did not. Men were less likely to have moderate or high anxiety (30%) (Table E4). Patients who received treatment for prostate cancer were less likely to have moderate or high anxiety (30%), and patients treated for rectal cancer were more likely to have moderate or high anxiety (75%).

Heart rate and anxiety

Mean heart rate per minute during treatment was 71.8, 76.9, and 81.3 for no or low anxiety, moderate anxiety, and high anxiety, respectively ($P = .04$, Table E5). There was no difference in the SD of the heart rate across the different categories of anxiety.

Discussion

This study showed that the patient experience of treatment on a 1.5 T MR-Linac when offering calming video content is good. Although only a selected group of patients preferred to have the video monitor on, when they did, they generally believed that it helped during treatment and that they were able to look at

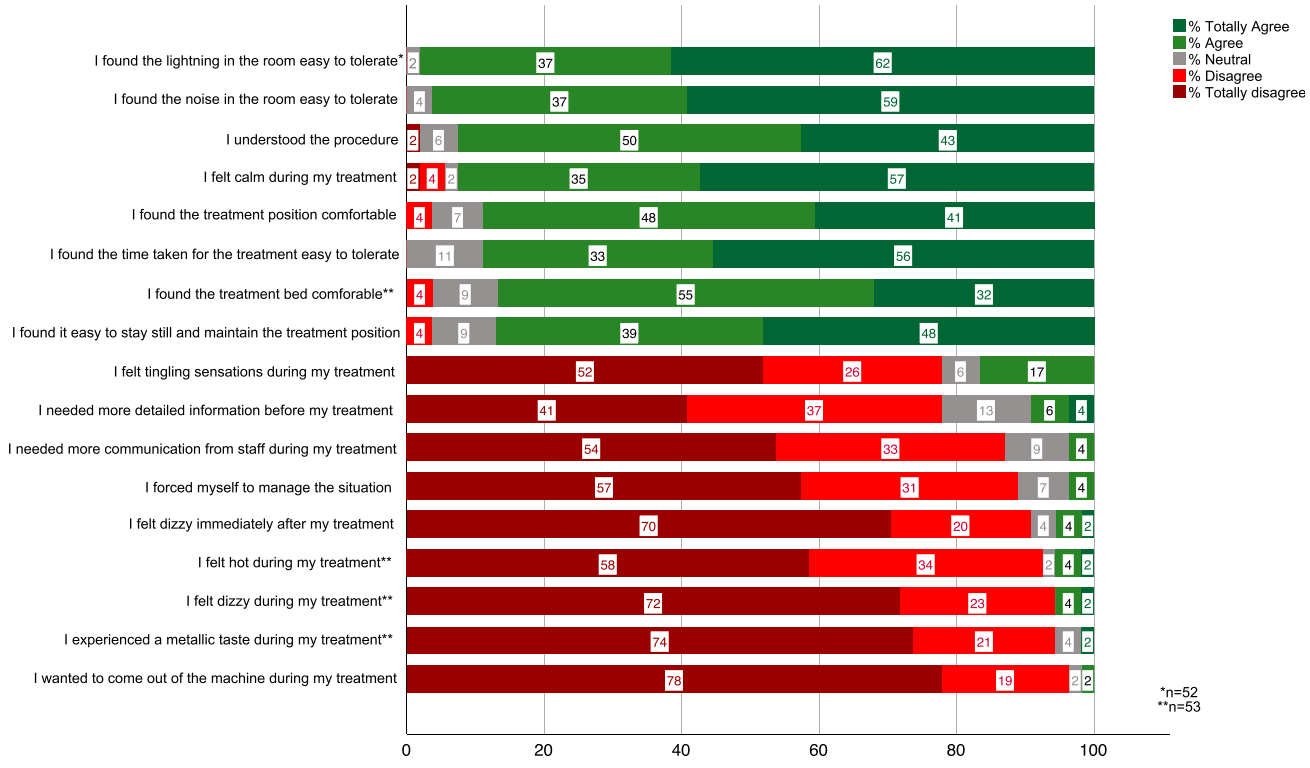

Figure 2 Patient experience of treatment on the MR-Linac after first treatment fraction with the option to look at a video monitor for 54 patients.
Abbreviations: MR-Linac = magnetic resonance guided linear accelerator.

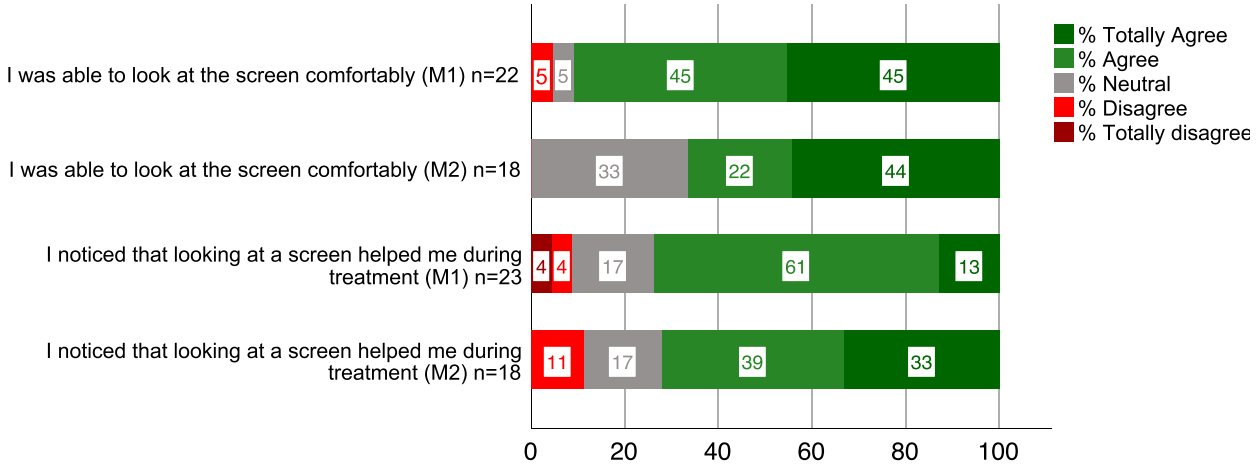

Figure 3 Experience of looking at a video monitor during MRgRT on a 1.5T MR-Linac.
Abbreviations: M1 = first treatment fraction; M2 = third, fourth, or fifth treatment fraction, MRgRT = magnetic resonance guided radiation therapy, MR-Linac = magnetic resonance guided linear accelerator.

the video monitor comfortably. Moreover, we found that anxiety was present during the treatment course, which was most frequently reported prior to their M1. Heart rate measuring during MR-Linac treatment was feasible.

These results of patient experience can be compared to a historical cohort of patients treated in the same institute on a 1.5 T MR-Linac without offering calming video content.[7] In general, answers to the questionnaires were comparable. Remarkable was the decrease in tingling

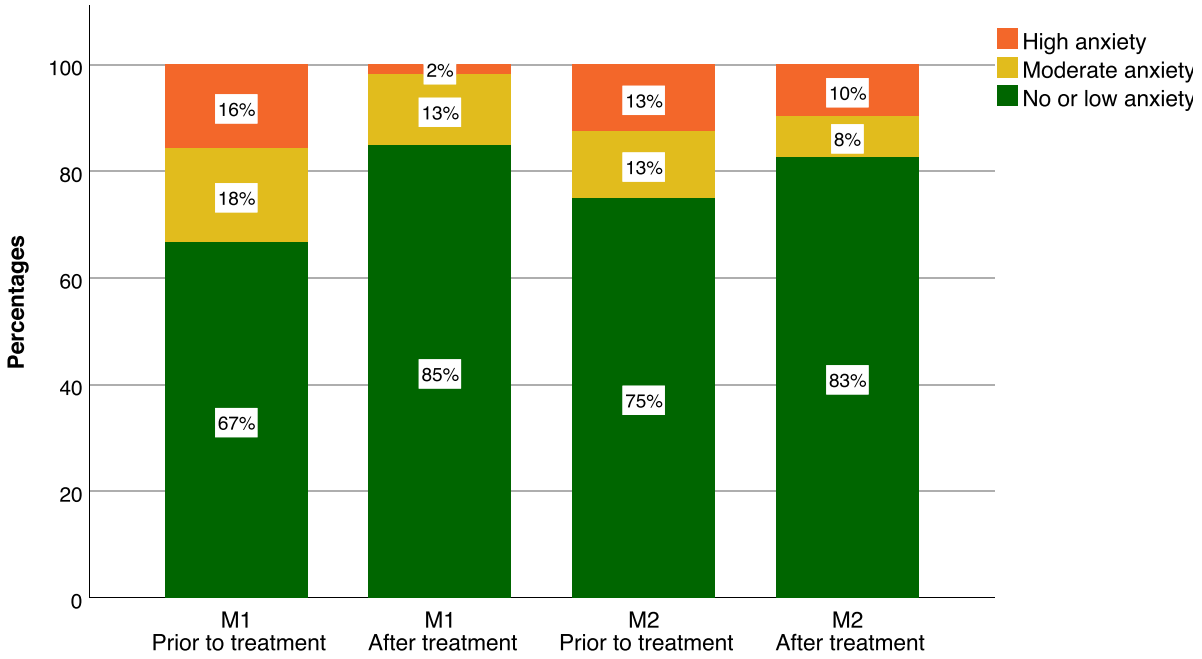

Figure 4 Prevalence of anxiety by means of the State-Trait Anxiety Inventory questionnaire during MRgRT on a 1.5T MR-Linac.

Abbreviations: M1 = first treatment fraction; M2 = third, fourth, or fifth treatment fraction, MRgRT = magnetic resonance guided radiation therapy, MR-Linac = magnetic resonance guided linear accelerator.

sensations from 28% in the historical cohort to 20% in our study. It is possible that calming video content contributed to this decline, although it is important to acknowledge that the results might have been influenced by a change in practice. Overall, this comparison indicates that patient experience did not improve drastically by offering patients calming video content. Patient experience of MRgRT could be compared with that of conventional treatment as computed tomography–guided radiation therapy is associated with shorter treatment time, less noise, and no confinement in a bore. The difference in patient experience between computed tomography–guided radiation therapy and MRgRT was previously investigated by Whiteside et al.[17] In 40 patients with prostate cancer, they found no significant difference between the 2 treatment modalities. However, previous observational studies show that patient experience might differ between various treatment indications,[6,18] which highlights the importance of continuing to monitor patient experience while the treatment techniques and indications for the MR-Linac are still evolving.

Although patient experience was good, and generally patients reported that they felt calm during treatment, anxiety was present throughout the course of radiation therapy. Anxiety is important to address because it can impact quality of life.[19] Sayan et al[5] reported that 45% of patients treated with MRgRT had some degree of anxiety after their M1, which is considerably higher than the 15% found in this study. It should be noted that the comparison should be done with caution because measures used to determine the level of anxiety differed. Sayan et al[5] used an in-house developed questionnaire in which anxiety was assessed using a single question, whereas this study used a validated questionnaire with 20 items to determine the level of anxiety. Other possible explanations for the difference could be the use of guided breath holds during treatment by Sayan et al,[5] which were not applied in our cohort, or a difference in included patients. Sayan et al[5] included 47% of patients with treatment for a lesion in the abdomen, and 20% in the thorax. In the present study, 68% of the included patients received treatment for prostate cancer, where the patient's head is more frequently toward the outside of the bore. This might be beneficial for patients with claustrophobia. Similar to our study, Sayan et al[5] found that anxiety reduced over patients' treatment course, which was also reported during conventional radiation therapy.[20,21] The measured level of anxiety also significantly reduced after patients' treatment fraction compared to just before. Possibly, a good treatment experience might reduce anxiety after treatment. With the design of the present study, the answer to whether calming video content contributed to this decrease in anxiety remains unclear.

For conventional radiation therapy, various interventions were studied to reduce anxiety prior to treatment. Suggested interventions were increased psychosocial support counseling[22,23] and improved patient education with video[21] or virtual reality.[24] Currently, in our department information is provided in a flyer and during counseling with the radiation oncologist and radiation

therapy technician. Future research should focus on whether patients need more information, what information patients are missing, and how they would like to receive that information.

Another important finding is that the current setup of the video monitor is comfortable for patients, which is relevant because the video monitor could be used for multiple purposes. For example, the monitor could be used for treatment notifications, since the noise of MRI scanning makes it difficult to verbally interact during imaging. Moreover, the setup could be used for biofeedback; if a patient receives information on their breathing, they could be guided to hold their breath at a certain level or regularize their breathing.[25] This could largely increase the efficiency of gating strategies for tumors that move during the breathing cycle.

The findings of the present study should be interpreted in the context of its limitations. The effect of looking at calming video content depends on the both the (position of the) video monitor and the content used. For this study, we chose to have comparable calming video content to limit the effect on heart rate. However, for some patients, this content was too monotonous. In the future, to achieve optimal distraction, content of choice would be most patient-friendly. Second, the single-arm study design with historical comparison for patient experience is prone to bias where a decline in tingling sensations might be due to change in patient guidance because of previous study results. Third, the sample population consisted of 89% men, which could affect generalizability. In our institute, the main treatment indications for MR-Linac are prostate cancer and lymph node metastasis after prostate cancer, which explains the large proportion of men in our sample. Since treatment indications for MR-Linac might differ per institute or change in the future, it is important to interpret our findings taking the large proportion of men into consideration. Finally, the positioning of the coils currently used, obstruct the correct placement of the mirror during the treatment of the head and neck region and therefore prevent the use of a video monitor during these treatments. The coils are nontransparent and quite large and need to be placed closely above the target. A dedicated head and neck coil with integrated mirror assembly would be needed for these patients.

In conclusion, the current setup for the in-room video monitor could be used for future studies because patients were able to comfortably view it during MRgRT. A sizable minority of patients preferred to watch calming videos that distracted them during treatment. Although patient experience was excellent, anxiety was present. Highest levels were reported prior to treatment, which declined after treatment. Future studies should investigate whether more information or additional attention could decrease anxiety prior to MRgRT.

Disclosures

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.adro.2024.101537.

References

1. de Mol van Otterloo SR, Christodouleas JP, Blezer ELA, et al. Patterns of care, tolerability, and safety of the first cohort of patients treated on a novel high-field MR-linac within the MOMENTUM study: Initial results from a prospective multi-institutional registry. *Int J Radiat Oncol Biol Phys*. 2021;111:867-875.
2. Winkel D, Bol GH, Kroon PS, et al. Adaptive radiotherapy: The Elekta Unity MR-Linac concept. *Clin Transl Radiat Oncol*. 2019;18:54-59.
3. Bertelsen AS, Schytte T, Møller PK, et al. First clinical experiences with a high field 1.5 T MR Linac. *Acta Oncol*. 2019;58:1352-1357.
4. Barnes H, Alexander S, Bower L, et al. Development and results of a patient-reported treatment experience questionnaire on a 1.5 T MR-Linac. *Clin Transl Radiat Oncol*. 2021;30:31-37.
5. Sayan M, Serbez I, Teymur B, et al. Patient-reported tolerance of magnetic resonance-guided radiation therapy. *Front Oncol*. 2020;10:1782.
6. Boeke S, Uder L, Ehlers J, et al. Online MR guided dose escalated radiotherapy for organ preservation in distal rectal cancer. *Clin Transl Radiat Oncol*. 2022;37:153-156.
7. de Mol van Otterloo SR, Westerhoff JM, Leer T, et al. Patient expectation and Experience of MR-guided radiotherapy using a 1.5T MR-Linac. *Tech Innov Patient Support Radiat Oncol*. 2024;29: 100224.
8. Goldsworthy S, Palmer S, Latour JM, McNair H, Cramp M. A systematic review of effectiveness of interventions applicable to radiotherapy that are administered to improve patient comfort, increase patient compliance, and reduce patient distress or anxiety. *Radiography (Lond)*. 2020;26:314-324.
9. Shimokawa K, Matsumoto K, Yokota H, et al. Anxiety relaxation during MRI with a patient-friendly audiovisual system. *Radiography (Lond)*. 2022;28:725-731.
10. Vogel W V, Valdés Olmos RA, Tijs TJW, et al. Intervention to lower anxiety of 18F-FDG PET/CT patients by use of audiovisual imagery during the uptake phase before imaging. *J Nucl Med Technol*. 2012;40:92-98.
11. George R, Chung TD, Vedam SS, et al. Audio-visual biofeedback for respiratory-gated radiotherapy: Impact of audio instruction and audio-visual biofeedback on respiratory-gated radiotherapy. *Int J Radiat Oncol Biol Phys*. 2006;65:924-933.

12. Kim T, Ji Z, Lewis B, et al. Visually guided respiratory motion management for Ethos adaptive radiotherapy. *J Appl Clin Med Phys*. 2022;23:e13441.
13. de Mol van Otterloo SR, Christodouleas JP, Blezer ELA, et al. The MOMENTUM study: An international registry for the evidence-based introduction of MR-guided adaptive therapy. *Front Oncol*. 2020;10:1328.
14. CiNii Research. Manual for the State-Trait Anxiety Inventory (self-evaluation questionnaire). Accessed September 26, 2023. https://cir.nii.ac.jp/crid/1370285712575158016.
15. Kayikcioglu O, Bilgin S, Seymenoglu G, Deveci A. State and trait anxiety scores of patients receiving intravitreal injections. *Biomed Hub*. 2017;2:1-5.
16. Sullivan GM, Feinn R. Using effect size-or why the *P* value is not enough. *J Grad Med Educ*. 2012;4:279-282.
17. Whiteside L, Nelder C, Pitt E, et al. Comparing patient acceptability of MR-guided radiotherapy to conventional CBCT on two Elekta systems: a questionnaire-based survey. *J Radiother Pract*. 2023;22: e50.
18. Uder L, Nachbar M, Butzer S, et al. Local control and patient reported outcomes after online MR guided stereotactic body radiotherapy of liver metastases. *Front Oncol*. 2022;12: 1095633.
19. Frick E, Tyroller M, Panzer M. Anxiety, depression and quality of life of cancer patients undergoing radiation therapy: a cross-sectional study in a community hospital outpatient centre. *Eur J Cancer Care (Engl)*. 2007;16:130-136.
20. Lewis F, Merckaert I, Liénard A, et al. Anxiety and its time courses during radiotherapy for non-metastatic breast cancer: A longitudinal study. *Radiother Oncol*. 2014;111:276-280.
21. Esen CSB, Yazici G, Hurmuz P, Ozyigit G, Zorlu F. The effect of video-based education on anxiety of patients receiving stereotactic radiosurgery and stereotactic body radiation therapy. *J Cancer Educ*. 2023;38:426-430.
22. Elsner K, Naehrig D, Halkett GKB, Dhillon HM. Reduced patient anxiety as a result of radiation therapist-led psychosocial support: a systematic review. *J Med Radiat Sci*. 2017;64:220-231.
23. van Beusekom MM, Cameron J, Bedi C, Banks E, Humphris G. Communication skills training for the radiotherapy team to manage cancer patients' emotional concerns: a systematic review. *BMJ Open*. 2019;9: e025420.
24. Grilo AM, Almeida B, Rodrigues C, Gomes AI, Caetano M. Using virtual reality to prepare patients for radiotherapy: a systematic review of interventional studies with educational sessions. *Tech Innov Patient Support Radiat Oncol*. 2023;25: 100203.
25. Keijnemans K, Borman PTS, Raaymakers BW, Fast MF. Effectiveness of visual biofeedback-guided respiratory-correlated 4D-MRI for radiotherapy guidance on the MR-Linac. *Magn Reson Med*. 2024;91:297-311.