

# Reminiscence therapy-based care program for reducing anxiety and depression in glioma survivors

## A randomized controlled trial

Xu Zhao, MB\* 

### Abstract

This study aimed to evaluate the effect of reminiscence therapy-based care (RTBC) program on anxiety, depression, patients satisfaction, and survival benefit in glioma patients after tumor resection.

A total of 150 eligible glioma patients were randomized into the RTBC group (N=75, receiving RTBC) and the control care (CC) group (N=75, receiving CC). Interventions were performed twice a month for 12 months. Anxiety was evaluated by Hospital Anxiety and Depression Scale (HADS) for anxiety score and Zung self-rating anxiety scale (SAS) score; meanwhile, depression was evaluated by HADS for depression score and Zung self-rating depression scale (SDS) score; additionally, patients satisfaction was scored. A 36-month follow-up was performed, and accumulating overall survival (OS) were calculated.

Both anxiety level and depression level were reduced in the RTBC group compared with the CC group at month 9 and month 12 (all  $P < .05$ ); meanwhile, the proportion of anxious patients and depressed patients were decreased in the RTBC group compared with the CC group at month 12 (all  $P < .05$ ). Moreover, patients satisfaction scores were increased in the RTBC group compared to the CC group at month 6, month 9, and month 12 (all  $P < .05$ ). Additionally, accumulating OS showed an increasing tendency in the RTBC group compared to the CC group, but no statistical significance was observed ( $P = .186$ ).

RTBC program ameliorates anxiety, depression, and promotes patients satisfaction in glioma patients after tumor resection.

**Abbreviations:** CC = control care, CKD = chronic kidney disease, HADS = Hospital Anxiety and Depression Scale, ITT = intention-to-treat, LOCF = last observation carried forward, OS = overall survival, RTBC = reminiscence therapy-based care, SAS = self-rating anxiety scale, SD = standard deviation, SDS = self-rating depression scale, WHO = World Health Organization.

**Keywords:** anxiety, depression, glioma, overall survival, reminiscence therapy

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This study was approved by the Institutional Review Boards of The First Affiliated Hospital of Harbin Medical University and conducted according to the principles described in the Declaration of Helsinki. All participants or their family members signed the informed consents.

The authors report no conflicts of interests.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Department of Neurosurgery, The First Affiliated Hospital of Harbin Medical University, Harbin, China.

\* Correspondence: Xu Zhao, Department of Neurosurgery, The First Affiliated Hospital of Harbin Medical University, 23 Youzheng Street, Harbin 150001, China (e-mail: zhaichunba3105@163.com).

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## 1. Introduction

Glioma is a common type of primary brain tumor that affects around 4 to 7 in every 100,000 people annually worldwide.<sup>[1]</sup> Patients with glioma suffer from the symptoms including headache, paresis, sensory loss, fatigue, cognitive deficits, anxiety, and depression, which greatly affect the quality of life of glioma patients.<sup>[2]</sup> Among the common symptoms of glioma, anxiety and depression are suggested to be paid attention, owing to that glioma patients along with anxiety and depression are related to a high incidence of cognitive impairment, decreased quality of life, or even increased suicide risk.<sup>[3–6]</sup> Current standard treatment for anxiety and depression in patients with chronic conditions is the combination of anxiolytics, antidepressants, and psychotherapy, however, it is unclear whether glioma patients might respond to anxiolytics or antidepressants.<sup>[7]</sup> What is worse, few randomized controlled trials have been conducted to evaluate psychotherapies for anxiety and depression in glioma patients.<sup>[8]</sup>

Reminiscence therapy is a kind of psychotherapy, which helps patients to gain self-identity, alleviates loneliness, anxiety, and depression by recalling past memories.<sup>[9]</sup> According to a previous study, reminiscence therapy reduces anxiety and depression in colorectal cancer patients undergoing postoperative chemotherapy.<sup>[10]</sup> Meanwhile, it also decreases anxiety and depression in

patients with Alzheimer's (which is characterized by cognitive deficits as glioma).<sup>[11]</sup> Based on the above-mentioned information, we hypothesized that reminiscence therapy could reduce anxiety and depression in glioma patients. However, little information is known about the effect of reminiscence therapy on anxiety and depression in glioma patients. Herein, we designed a reminiscence therapy-based care (RTBC) program, aiming to evaluate its effect on anxiety, depression, patients satisfaction, and survival benefit in glioma patients after tumor resection.

## 2. Methods

### 2.1. Participants

This was a randomized, controlled study. A total of 150 glioma patients who underwent resection in our hospital between January 2013 and June 2016 were consecutively recruited. Patients were eligible for inclusion in the study if they met following criteria:

1. diagnosed as glioma confirmed by pathological examination;
2. age  $\geq 18$  years old;
3. able to understand the study contents and had no difficulty in fulfilling assessment about anxiety and depression;
4. willing to accept study intervention and comply with follow-up schedule;
5. no severe mental disorder (e.g., schizophrenia, bipolar disorder, schizoaffective disorder, affective psychosis, paranoid psychosis, severe mental retardation, mania).

While patients were excluded from the study if they

1. were incapacitated or paralyzed,
2. had severe visual impairment, aphasia, hearing impairment or communication barrier,
3. complicated with other malignant tumors or uncontrolled concomitant diseases,
4. were pregnant or breast-feeding women.

This study was approved by the Institutional Review Boards of our hospital and conducted according to the principles described in the Declaration of Helsinki. All participants or their family members signed the informed consent.

### 2.2. Baseline data collection

The demographic characteristics (age, gender, education duration, marriage status, employment status before surgery), chronic complications (hypertension, hyperlipidemia, diabetes, and chronic kidney disease (CKD)), World Health Organization (WHO) grade for glioma, and adjuvant therapy were documented.

### 2.3. Randomization and grouping

After the eligibility was confirmed and the written informed consent was provided, the patient was randomly assigned to receive the RTBC program (RTBC group, N=75) or the "control care" (CC group, N=75) for 12 months. A blocked randomization method with a block size of 4 was used, and patients were assigned to each group in a 1:1 ratio. Sequential numbers were assigned to 150 sealed, opaque envelopes, which contained the assigned treatment group for each patient, according to the blocked randomization table. Envelopes were opened by the

investigator right after surgery in sequential order for each qualifying patient.

### 2.4. Intervention

After surgery, appropriate adjuvant therapy was administered to patients, meanwhile, all patients were given usual care according to the postoperative status, such as regular surveillance, speech and swallowing therapy, psychological guidance, rehabilitation engineering, drug management, and nutrition support. In addition, disease-related health education was administered to all patients before discharge from the hospital.

After discharge, in the CC group, patients were invited to the rehabilitation center of our hospital to receive "control care" including physical therapy, cognitive and behavioral therapy, and occupational therapy. The "control care" was performed in small groups (each group contained 7 to 10 patients who were enrolled in the same month or adjacent month) twice a month for 12 months and each lasted 60 minutes, which was conducted by trained nurses who were trained and given practical guidelines to follow. The physical therapy was dominated by exercise therapy including muscle training, endurance training, neuromuscular training, balance and coordination training, gait training and breathing training; the cognitive and behavioral therapy comprised of attention training, memory training, orientation training, calculation training, problem-solving and executive capacity training; the occupational therapy was to use a variety of activities related to daily life and work or a certain exercise as a training method, ultimately, to improve the patients independence in life, work, and leisure activities.

After discharge, in the RTBC group, patients were administered with reminiscence therapy and the "control care" (as same as that in the CC group). Patients were invited to the rehabilitation center of our hospital to receive the "control care" and reminiscence therapy conducted by trained nurses twice a month for 12 months. The "control care" was performed in small groups, and the reminiscence therapy was administered in the form of group sessions. Each group contained 7 to 10 patients who were enrolled in the same month or adjacent month. Both the "control care" and reminiscence therapy lasted 60 minutes, resulting in a total of 120 minutes for each intervention. At each intervention, the first 60 minutes were used for "control care", and the remaining 60 minutes were used for reminiscence therapy. The "control care" was performed as same as that in the control group. A total of 24 scheduled sessions for the reminiscence therapy, which comprised of 12 themes:

1. introducing yourself and brief family history;
2. talking about the childhood memories and favorite games;
3. sharing school life and memories related to adolescence and youth;
4. talking about the memories of wooing and marriage;
5. sharing career experiences and achievements;
6. highlighting roles of the individuals at home and corporation;
7. elaborating a decisive event in one life (a decisive event was an experience that one had in his or her life leading to a major change in life);
8. sharing your individual photos and telling their story;
9. sharing friend stories;
10. sharing memory of hometown;
11. talking about Chinese opera, old movies or songs;

12. reviewing overall 24 sessions and farewell.

The reminiscence therapy was performed in a safe and comfortable environment, and the session was carried in a brightly lit, sizeable space with a quiet, warm, and relaxed atmosphere. Participants were advised to sit in a circle, which allowed them to have eye contact, to hear, and to communicate with others in the group whenever they wanted. A series of warm-up activities were introduced at the beginning of the intervention, such as singing together and simple healthy exercise to provide the participants with a pleasurable interaction and induce participation in the group process. During each intervention, participants were encouraged to review and conclude their past events. Meaningful materials, such as favorite songs, significant documents, and pictures, were used to evoke memories of valuable accomplishments and also assisted participants in regaining a meaning of life. The trained nurse was responsible for leading the patient to participate actively and closely observing the participants for increased agitation and anxiety during the session.

### 2.5. Assessments during the 12-month intervention period

In the present study, the anxiety status of patients was assessed using Hospital Anxiety and Depression Scale for anxiety (HADS-A) and Zung self-rating anxiety scale (SAS); the depression status of patients was evaluated using Hospital Anxiety and Depression Scale for depression (HADS-D) and Zung self-rating depression scale (SDS). Both the anxiety and depression assessments were conducted at baseline (M0), month 3 (M3), month 6 (M6), month 9 (M9), and month 12 (M12). HADS-A and HADS-D score were ranging from 0 to 21, and the HADS-A score  $\geq 8$  or HADS-D score  $\geq 8$  was considered as anxiety or depression, correspondingly.<sup>[12]</sup> SAS score and SDS score were ranging from 0 to 100, and the SAS score  $\geq 50$  or SDS score  $\geq 50$  was considered as anxiety or depression, accordingly.<sup>[13,14]</sup> In addition, patients' satisfaction was scored at M3, M6, M9, and M12. The patients satisfaction score was ranging from 0 to 10 points, where 0 indicated the worst satisfaction, and 10 indicated the best satisfaction.

### 2.6. Long-term follow-up

After the 12-month intervention, follow-up for all patients was gone on, which was mainly conducted by telephone calls or clinic visits and continued up to patients death or completion of a total 36-month visit. The survival status was documented during follow-up, and overall survival (OS) was assessed, which was defined as the time interval from the initiation of intervention to the death. Patients who lost follow-up were censored on the date of their last visits.

### 2.7. Sample size calculation

Using the PASS 11.0 software (NCSS, USA), the minimum sample size was respectively estimated based on the following hypotheses (which were set up based on the clinical experience of the investigators and previous studies<sup>[15-17]</sup>):

1. at M12, mean HADS-A score was 6 in the RTBC group with standard deviation (SD) of 3, and mean HADS-A score was 8 in the CC group with SD of 4; based on this hypothesis, with a 90% power, 1:1 ratio and the significance level of 0.05, the required minimum sample size was 67 in each group;

2. at M12, mean SAS score was 40 in the RTBC group with SD of 15, and mean SAS score was 50 in the CC group with SD of 15; based on this hypothesis, with a 90% power, 1:1 ratio and the significance level of 0.05, the required minimum sample size was 49 in each group.

As a result, the required minimum sample size was 67 at least in each group. Additionally, considering a possible 10% rate of loss to follow-up, the final sample size was increased to 75 in each group.

### 2.8. Statistical analysis

Statistical analysis was performed on SPSS 24.0 statistical software (IBM, Chicago, IL, USA), and graphics were drawn using GraphPad Prism 7.01 software (GraphPad Software Inc., San Diego, CA, USA). All 150 patients were included in the final analysis based on the intention-to-treat (ITT) principles. The last observation carried forward (LOCF) method was applied to process missing data. Data were displayed as mean value  $\pm$  SD or count (percentage). Between-group comparisons were determined by Student *t* test, Chi-Squared test, or Wilcoxon rank-sum test. OS was displayed using the Kaplan–Meier curve, and the comparison of OS between 2 groups was determined by the log-rank test. *P* value  $< .05$  was considered as statistically significant.

## 3. Results

### 3.1. Study flow

A total of 182 glioma patients were screened for eligibility and 32 of them were excluded (including 25 patients who either did not meet the inclusion criteria or met the exclusion criteria and 7 patients who disagreed to sign informed consent). The remaining 150 glioma patients were randomized at a ratio of 1:1 into the RTBC group (N=75) (receiving RTBC program) and the CC group (N=75) (receiving control care). During the 12-months intervention, anxiety and depression were assessed at M0, M3, M6, M9, and M12, respectively; and patients satisfaction was scored at M3, M6, M9, and M12, respectively. After the intervention, patients were followed-up to death or completion of the 36-month visit. In the RTBC group, 2 (2.7%) patients lost follow-up during the intervention and another 8 (11.0%) patients lost follow-up during the follow-up period; finally, all 75 patients were included in the final analysis based on ITT principles. In the CC group, 2 (2.7%) patients lost follow-up during the intervention and another 4 (5.5%) patients lost follow-up during the follow-up period; at last, all 75 patients were included in the final analysis based on ITT principles (Fig. 1).

### 3.2. Basic characteristics

The mean age of the RTBC group and the CC group was  $48.7 \pm 10.6$  and  $50.8 \pm 11.3$  years, respectively. There were 29 (38.7%) females and 46 (61.3%) males in the RTBC group, and 33 (44.0%) females as well as 42 (56.0%) males in the CC group. Further analysis showed that no difference was found in any of the demographic characteristics between the 2 groups (all  $P > .05$ ). As to glioma WHO grade, the numbers of patients with WHO grade I, II, III, and IV were 3 (4.0%), 30 (40.0%), 26 (34.7%), and 16 (21.3%), respectively in the RTBC group, and were 5 (6.7%), 27 (36.0%), 31 (41.3%), as well as 12 (16.0%), respectively in the CC group. Regarding anxiety status at

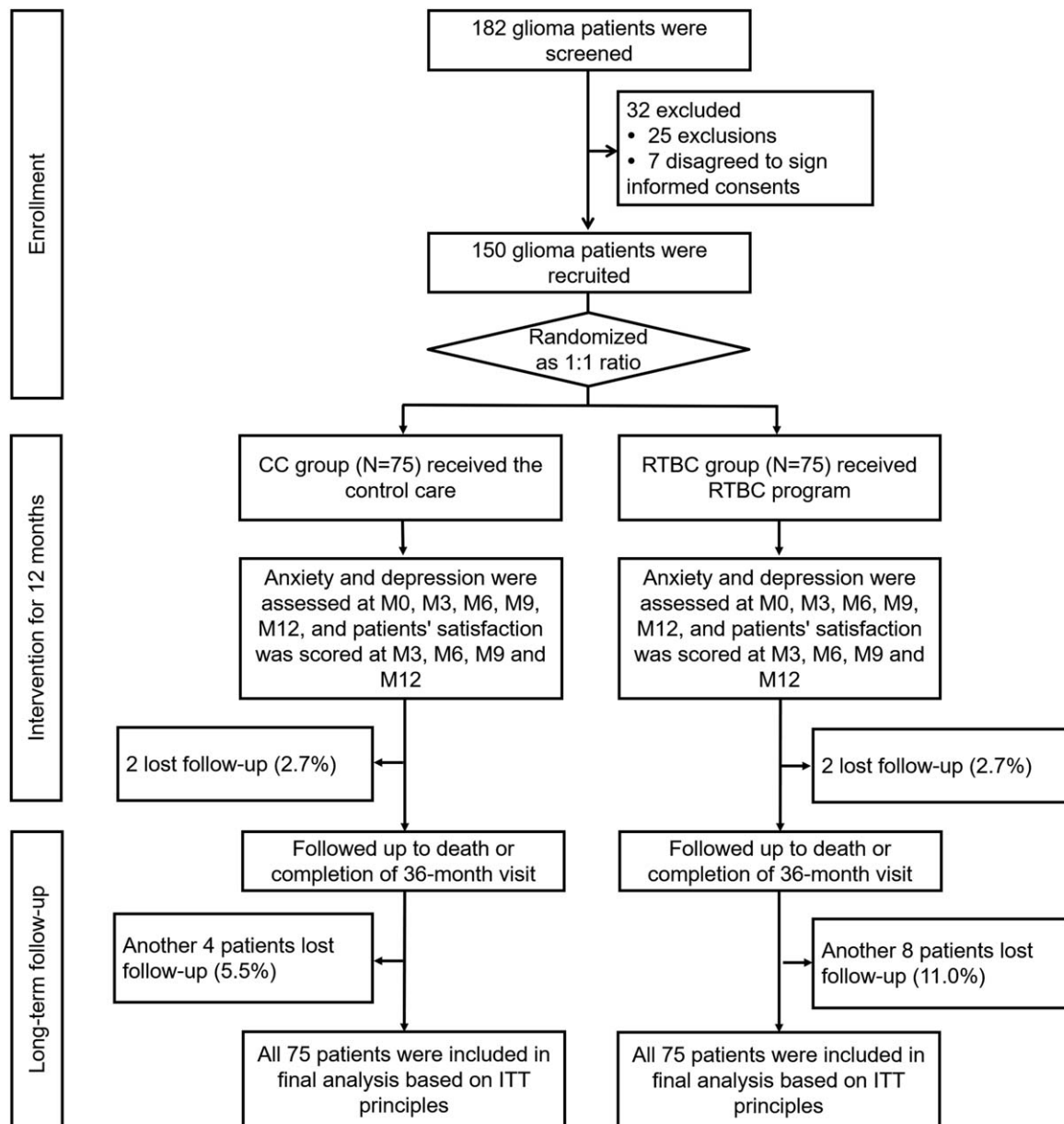


Figure 1. Study flow chart. CC = control care; RTBC = reminiscence therapy-based care; M = month; ITT = intention-to-treat.

baseline: in the RTBC group, the mean HADS-A score was  $7.2 \pm 4.3$  and there were 26 (34.7%) HADS anxiety patients; the mean SAS score was  $44.3 \pm 9.6$  and there were 22 (29.3%) SAS anxiety patients; in the CC group, the mean HADS-A score was  $7.4 \pm 4.0$  and there were 26 (34.7%) HADS anxiety patients; the mean SAS score was  $43.4 \pm 10.5$  and there were 23 (30.7%) SAS anxiety patients. For depression status at baseline: in the RTBC group, the mean HADS-D score was  $6.5 \pm 3.1$  and there were 22 (29.3%) depression patients; the mean SDS score was  $43.3 \pm 10.7$ , and there were 21 (28.0%) SDS depression patients; meanwhile in the CC group, the mean HADS-D score was  $7.1 \pm 4.1$  and there were 24 (32.0%) depression patients; the mean SDS score was  $43.7 \pm 10.0$ , and there were 20 (26.7%) SDS depression patients. The detailed basic characteristics were listed in Table 1.

Further analyses showed no difference in any of the clinical characteristics between the 2 groups (all  $P > .05$ ).

### 3.3. Effect of RTBC program on anxiety

HADS-A score was decreased in the RTBC group compared to the CC group at M9 ( $P = .024$ ) and M12 ( $P = .010$ ), whereas no difference was found between the 2 groups at M0, M3 or M6 (all  $P > .05$ ) (Fig. 2A). Meanwhile, the proportion of HADS anxiety patients was reduced in the RTBC group compared to the CC group at M12 ( $P = .041$ ), while no difference was found between the 2 groups at M0, M3, M6, or M9 (all  $P > .05$ ) (Fig. 2B). Regarding the SAS score, it was lower in the RTBC group compared to the CC group at M6 ( $P = .044$ ), M9 ( $P = .025$ ), and

**Table 1****Basic characteristics of glioma patients.**

Items	CC group (N = 75)	RTBC group (N = 75)	P value
Demographic characteristics			
Age (years), mean ± SD	50.8 ± 11.3	48.7 ± 10.6	.243
Gender, No. (%)			.507
Female	33 (44.0)	29 (38.7)	
Male	42 (56.0)	46 (61.3)	
Education duration (years), mean ± SD	10.4 ± 3.7	11.1 ± 3.1	.233
Marry status, No. (%)			.716
Single/divorced/widowed	20 (26.7)	22 (29.3)	
Married	55 (73.3)	53 (70.7)	
Employment status before surgery, No. (%)			.535
Unemployed	16 (21.3)	13 (17.3)	
Employed	59 (78.7)	62 (82.7)	
Chronic complications			
Hypertension, No. (%)	22 (29.3)	20 (26.7)	.716
Hyperlipidemia, No. (%)	11 (14.7)	9 (12.0)	.631
Diabetes, No. (%)	8 (10.7)	7 (9.3)	.785
CKD, No. (%)	4 (5.3)	5 (6.7)	.731
WHO grade, No. (%)			
I	5 (6.7)	3 (4.0)	
II	27 (36.0)	30 (40.0)	
III	31 (41.3)	26 (34.7)	
IV	12 (16.0)	16 (21.3)	
Adjuvant therapy, No. (%)			
Radiotherapy	43 (57.3)	49 (65.3)	.314
Chemotherapy	29 (38.7)	30 (40.0)	.867
Anxiety status at baseline			
HADS-A score, mean ± SD	7.4 ± 4.0	7.2 ± 4.3	.768
HADS anxiety patients, No. (%)	26 (34.7)	26 (34.7)	1.000
SAS score, mean ± SD	43.4 ± 10.5	44.3 ± 9.6	.550
SAS anxiety patients, No. (%)	23 (30.7)	22 (29.3)	.859
Depression status at baseline			
HADS-D score, mean ± SD	7.1 ± 4.1	6.5 ± 3.1	.329
HADS depression patients, No. (%)	24 (32.0)	22 (29.3)	.723
SDS score, mean ± SD	43.7 ± 10.0	43.3 ± 10.7	.801
SDS depression patients, No. (%)	20 (26.7)	21 (28.0)	.855

Comparison was determined by Student *t* test, Chi-Squared test or Wilcoxon rank sum test. CC = control care, CKD = chronic kidney disease, HADS-A = hospital anxiety and depression scale-anxiety, HADS-D = hospital anxiety and depression scale-depression, RTBC = reminiscence therapy-based care program, SAS = self-rating anxiety scale, SD = standard deviation, SDS = self-rating depression scale, WHO = world health organization.

M12 ( $P = .004$ ), but similar at M0 and M3 (both  $P > .05$ ) (Fig. 2C). The proportion of SAS anxiety patients was decreased in the RTBC group compared to the CC group at M9 ( $P = .044$ ) and M12 ( $P = .013$ ), however, no difference was found between the 2 groups at M0, M3 or M6 (all  $P > .05$ ) (Fig. 2D).

### 3.4. Effect of RTBC program on depression

HADS-D score was decreased in the RTBC group compared to the CC group at M6 ( $P = .049$ ), M9 ( $P = .006$ ), and M12 ( $P = .013$ ), while no difference was observed between the 2 groups at M0 or M3 (both  $P > .05$ ) (Fig. 3A). The proportion of HADS depression patients was reduced in the RTBC group compared to the CC group at M9 ( $P = .047$ ) and M12 ( $P = .044$ ), but was similar at M0, M3, and M6 (all  $P > .05$ ) (Fig. 3B). Meanwhile, SDS score was lower in the RTBC group compared to the CC group at M12 ( $P = .029$ ), whereas no difference was found between the 2 groups at M0, M3, M6 or M9 (all  $P > .05$ ) (Fig. 3C). The proportion of SDS depression patients showed a trend to decrease in the RTBC group compared to the CC group at M6, M9, and M12, but no statistical significance was observed (all  $P > .05$ ) (Fig. 3D).

### 3.5. Effect of RTBC program on patients satisfaction

Patients satisfaction score was increased in the RTBC group compared to the CC group at M6 ( $P = .044$ ), M9 ( $P = .015$ ), and M12 ( $P = .027$ ), while no difference was found between the 2 groups at M3 ( $P = .119$ ) (Fig. 4).

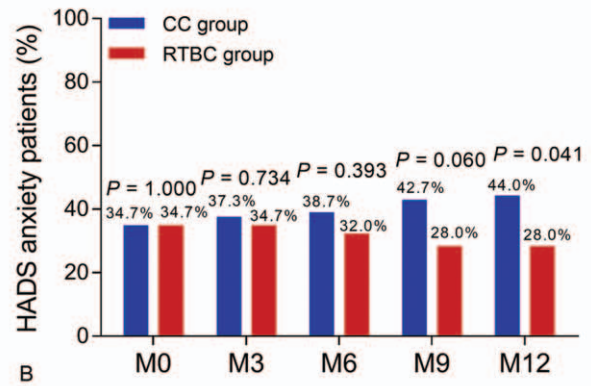
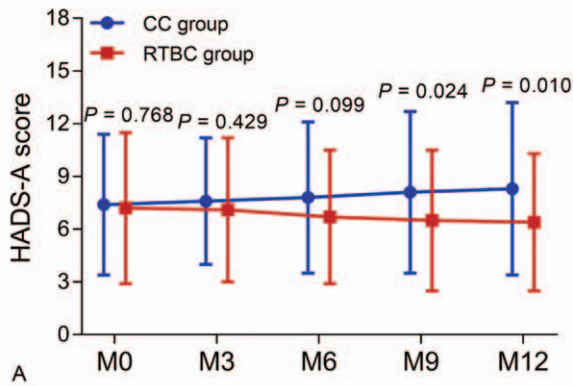
### 3.6. Effect of RTBC program on OS

The mean OS was 30.9 months (95% CI: 28.8–32.9 months) in the RTBC group and was 28.8 months (95% CI: 26.4–31.2 months) in the CC group. Meanwhile, the accumulating OS showed a minor increasing tendency in the RTBC group compared to the CC group, but no statistical significance was found ( $P = .186$ ) (Fig. 5).

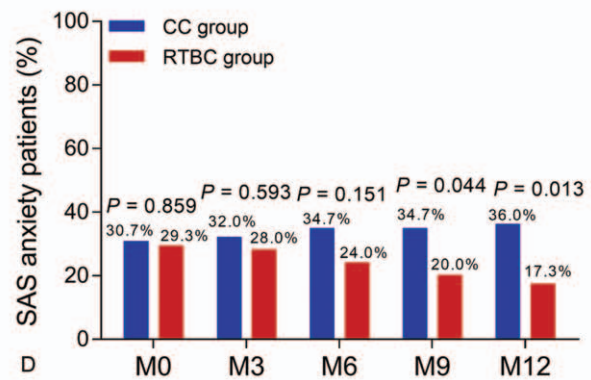
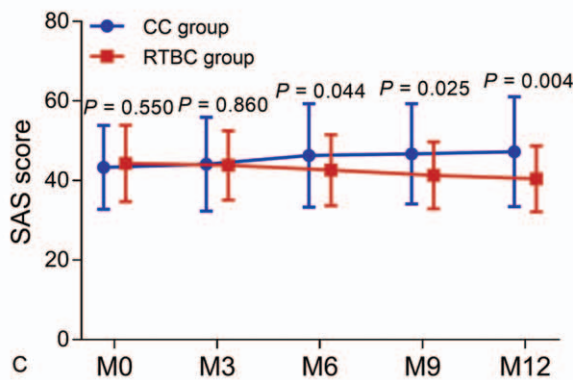
## 4. Discussion

This study revealed that compared with regular CC, the RTBC program reduced anxiety and depression levels in glioma patients after surgery; meanwhile, the RTBC program could also reduce the proportions of patients with anxiety or depression compared with CC; besides, the RTBC program promoted satisfaction

Based on HADS-A score



Based on SAS score



**Figure 2.** Comparison of anxiety between the RTBC group and the CC group. Comparison of HADS-A score (A), the proportion of HADS anxiety patients (B), SAS score (C), and the proportion of SAS anxiety patients (D) between the RTBC group and the CC group. HADS = Hospital Anxiety and Depression Scale; HADS-A = Hospital Anxiety and Depression Scale for anxiety; SAS = Zung self-rating anxiety scale; CC = control care; RTBC = reminiscence therapy-based care; M = month.

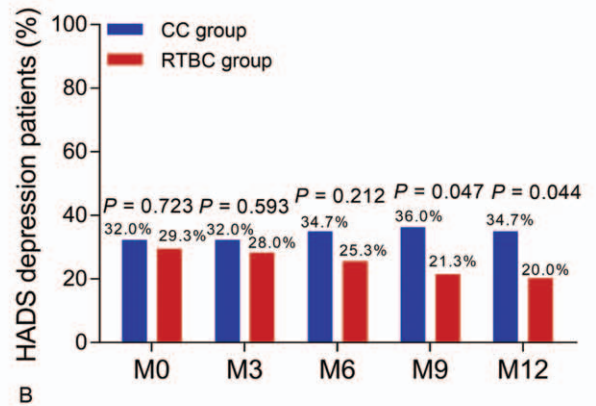
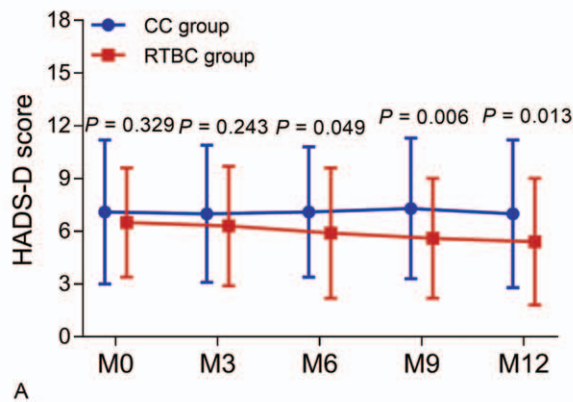
levels compared with CC in glioma patients after surgery; moreover, compared with CC, the RTBC program tend to prolong patients OS, while no statistical significance was observed.

Anxiety and depression are well-recognized complications of glioma, and the frequency of glioma patients developing anxiety and depression ranges from 8% to 24%.<sup>[18]</sup> Meanwhile, it is proposed that anxiety and depression are associated with the reduction of physical function, cognitive impairment, the decline of quality of life, and most importantly, worse outcomes in glioma patients.<sup>[15]</sup> Thus, ameliorating anxiety and depression might be beneficial for glioma patients. However, the effect of anxiolytics and antidepressants in glioma patients is largely unclear<sup>[7]</sup> and only a few studies have been conducted before to evaluate the effect of treatment against anxiety and depression in glioma patients. One previous study showed that a dyadic yoga program has a median effect on ameliorating depression in high-grade glioma patients undergoing radiotherapy.<sup>[19]</sup> While another study fails to show the advantage of an internet-based guided self-help program against waiting list control in reducing depression in glioma patients.<sup>[20]</sup> Therefore, additional exploration of management for anxiety and depression in glioma patients is necessary.

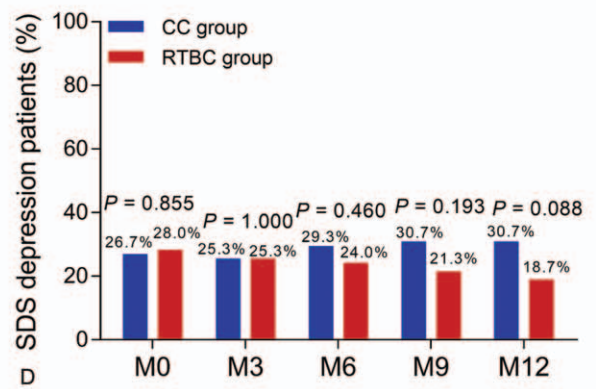
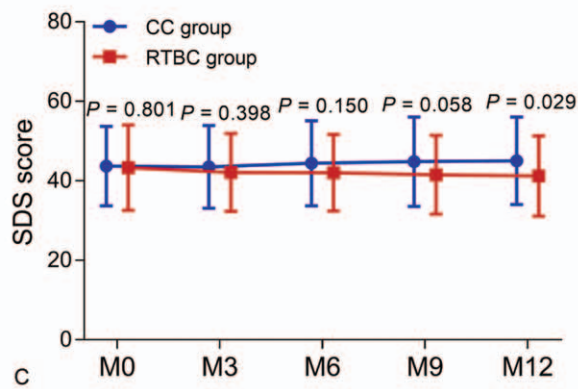
Reminiscence therapy is a psychotherapy that uses recalling past events, feelings, and thoughts to achieve multiple goals including establishing self-identity, promoting communication, reducing boredom, etc.<sup>[21]</sup> Meanwhile, previous studies have identified reminiscence therapy as effective psychotherapy to treat anxiety and depression in patients with brain diseases (including Alzheimer patients)<sup>[11,22,23]</sup>; however, its effect on anxiety and depression in glioma patients is unclear. In the present study, we designed an RTBC program (which included 24 sessions of grouped reminiscence therapy) and aimed to investigate its effect on anxiety as well as depression in glioma patients after operation. Data revealed that the RTBC program had a better effect on reducing anxiety and depression compared to control care in glioma patients. Possible explanations of our data might be that:

1. Reminiscence therapy might help glioma patients to build self-identity, reduce boredom and promote intimacy maintenance by recalling past events and share these events with other patients, which could improve well-being, decrease anxiety as well as depression of glioma patients (as in patients with Alzheimers disease<sup>[23]</sup>);
2. The RTBC program contained a grouped reminiscence therapy to encourage the social contact among patients, to

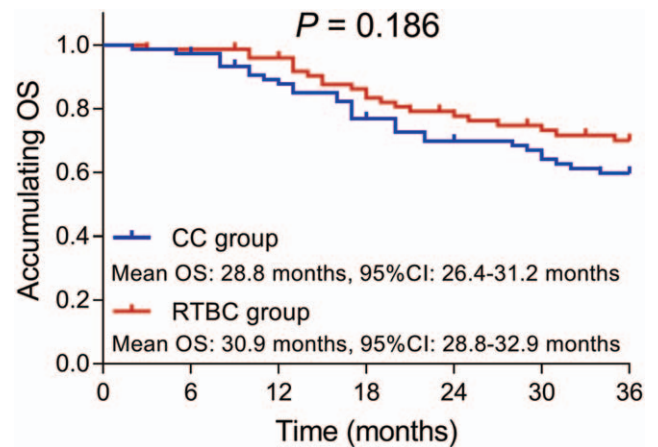
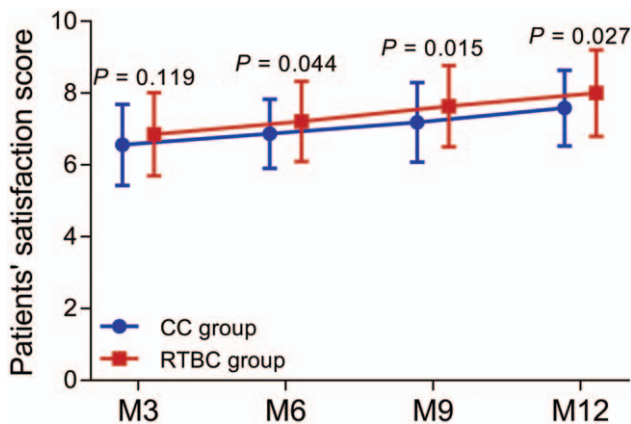
Based on HADS-D score



Based on SDS score



**Figure 3.** Comparison of depression between the RTBC group and the CC group. Comparison of HADS-D score (A), the proportion of HADS depression patients (B), SDS score (C), and the proportion of SDS depression patients (D) between the RTBC group and the CC group. HADS = Hospital Anxiety and Depression Scale; HADS-D = Hospital Anxiety and Depression Scale for depression; SDS = Zung self-rating depression scale; CC = control care; RTBC = reminiscence therapy-based care; M = month.



**Figure 4.** Comparison of patients satisfaction score between the RTBC group and the CC group. CC = control care; RTBC = reminiscence therapy-based care; M = month.

**Figure 5.** Comparison of accumulating OS between the RTBC group and the CC group. OS = overall survival; CI = confidence interval; CC = control care; RTBC = reminiscence therapy-based care.

improve their communication skills and to establish new relationships,<sup>[21]</sup> which could help decrease anxiety and depression in glioma patients;

3. The combination of reminiscence therapy and control care might have a better effect on cognitive and behavioral therapy, which reduced the cognitive deficit and further decreased anxiety as well as depression in glioma patients;
4. The RTBC program combined reminiscence therapy with control care and prolonged the total intervention time, which might improve the intervention effect on ameliorating patients anxiety and depression.

Additionally, we also found that RTBC program improved patients satisfaction, which could be explained by that:

1. The RTBC program reduced anxiety and depression in glioma patients (mentioned above), thus it directly improved glioma patients satisfaction;
2. The RTBC program contained reminiscence therapy, which could ameliorate anxiety and depression to make patients more positive to receive treatment,<sup>[24]</sup> which might improve the recovery of glioma patients, thus increasing glioma patients satisfaction indirectly.

Anxiety and depression are associated with the negative outcome of glioma patients.<sup>[5]</sup> In order to further investigate whether the RTBC program could impact the outcomes of glioma patients, we performed a follow-up of 36-month and found that the RTBC program had a minor effect on accumulating OS in glioma patients compared to control care, but no statistical significance was found. Meanwhile, a minor tendency in the increase of mean OS was also observed (30.9 months for the RTBC group vs 28.9 months for the CC group). Possible explanations for our data might be that:

1. the RTBC program reduced depression (which was associated with worse prognosis according to a previous study<sup>[25]</sup>) compared with control care in glioma patients, thus it might promote OS in glioma patients;
2. in this study, the follow-up duration was relatively short and the sample size was relatively small, which might cause less effective events and low statistical power;
3. the main factors that affect OS in glioma patients were tumor characteristics,<sup>[26]</sup> whereas they were similar between the 2 groups, which might weaken the effect of RTBC program.

Therefore, no statistical significance was observed in accumulating OS between the 2 groups.

Although we had found some interesting results, there were several limitations to this study. Firstly, the sample size of this study was relatively small, which might cause low statistical power, and further studies with larger sample sizes could be conducted to verify our findings. Secondly, although we had elongated the follow-up period to 36 months after the intervention, it was not long enough to evaluate the effect of the RTBC program on the long-term prognosis of glioma patients, which could be investigated further. Thirdly, this study was single-centered, which might cause selection bias; therefore, a multiple-centered study could be performed to provide a more objective prospect on the potential of the RTBC program in managing anxiety and depression in glioma patients. Finally, it was difficult to achieve blindness due to the difference in intervention methods of this study; therefore, there might exist patients self-evaluation bias.

To be conclusive, the RTBC program alleviates anxiety, depression, and improves patients satisfaction in glioma patients after tumor resection. The RTBC program might be a potential care program to manage anxiety and depression in glioma patients who underwent resection.

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## Author contributions

**Conceptualization:** Xu Zhao.

**Data curation:** Xu Zhao.

**Formal analysis:** Xu Zhao.

**Software:** Xu Zhao.

**Supervision:** Xu Zhao.

**Writing – original draft:** Xu Zhao.

**Writing – review & editing:** Xu Zhao.

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