Original Article

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ISSN: 1735-0344 *Tanaffos 2024; 23(4): 403-408*

TANAFFOS

Effectiveness of Cognitive Behavioral Therapy and Motivational Interviewing on Perceived Stress and ICU Stay in Neurosurgical Patients: A Quasi-Experimental Study

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Received: 30 December 2023

Accepted: 8 July 2024

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Background: Neurosurgical operations, especially for brain tumors, are among the most stressful medical procedures due to diagnostic uncertainties, high morbidity, and long post-operative recovery, including ICU admission. Stress management interventions may improve outcomes. This study aimed to compare the effectiveness of Cognitive Behavioral Therapy (CBT) and Motivational Interviewing (MI) in reducing perceived pre- and post-operative stress and ICU stay in patients undergoing brain surgery.

Materials and Methods: In a quasi-experimental design, 80 neurosurgical candidates admitted to Shohadaye Tajrish Hospital during 2020–2022 were randomly assigned to intervention and control groups. The intervention group received 15 CBT-based sessions focused on stress management and cognitive restructuring. Stress levels were assessed using Cohen's Perceived Stress Scale (1983), and CBT protocols followed Miller (2003). Data were analyzed with SPSS using chi-square tests, independent and paired t-tests, and ANCOVA.

Results: Patients who received CBT demonstrated significantly lower perceived stress scores postoperatively ($p<0.001$) and had a shorter ICU stay by an average of 3.2 days ($p=0.049$). No significant demographic differences were observed between groups.

Conclusion: CBT significantly reduces perioperative stress and ICU duration in neurosurgical patients. Integrating psychological interventions like CBT into preoperative care protocols may enhance recovery, reduce complications, and lower healthcare costs.

Keywords: Neurosurgery; ICU; Perceived Stress; Cognitive Behavioral Therapy; Motivational Interviewing

INTRODUCTION

The World Health Organization defines health as a state of complete physical, mental, and social well-being, not merely the absence of disease (1). Neurosurgical procedures—particularly brain tumor surgeries—are among the most invasive and psychologically distressing interventions in medicine. Factors such as diagnostic uncertainty, potential postoperative deficits, and exposure to high-acuity environments like the ICU contribute to substantial patient stress (2).

Stress, conceptualized as the body's physiological and psychological reaction to perceived threats, is a known predictor of adverse surgical outcomes. Elevated stress correlates with suppressed immune functioning, impaired wound healing, and higher incidences of cardiovascular and neurological complications (3). In neurosurgical contexts, these risk factors are notably intensified by procedural complexity and ICU environments (2).

Preoperative "perceived stress" refers to patients' subjective appraisals of their situations as unpredictable, uncontrollable, or overwhelming (4). Studies indicate that elevated preoperative stress is associated with increased anxiety and depression symptoms, prolonged hospitalization, and poor recovery trajectories (5, 6). Specifically, up to 80% of patients undergoing brain surgery report preoperative anxiety, which is linked to longer hospitalizations and diminished postoperative cognitive performance (2).

Cognitive Behavioral Therapy (CBT) is a structured intervention targeting maladaptive thoughts and behaviors contributing to emotional distress (7). Numerous randomized controlled trials across various surgical populations—including sinus, orthopedic, and cardiac patients—have demonstrated that perioperative CBT significantly reduces anxiety and stress and shortens hospital stays (8-10).

Motivational Interviewing (MI) is a client-centered, directive counseling approach effective in enhancing intrinsic motivation and resolving ambivalence (11). In medical care settings, MI has demonstrated moderate yet consistent efficacy in improving behavioral change, treatment adherence, and psychological outcomes across both chronic and acute care populations, including postoperative settings (12). A 2024 pilot RCT within an ERAS protocol for colorectal surgery demonstrated that MI effectively improved postoperative mobilization, an encouraging finding for its perioperative application (13).

Despite robust evidence supporting CBT and MI in general surgical populations, there remains a significant gap in the literature regarding their application in neurosurgical patients, especially those undergoing craniotomies for brain tumors. The unique neurocognitive and psychological vulnerabilities of these patients, coupled with the high incidence of ICU admission, suggest that stress reduction strategies may be especially beneficial. Yet, current perioperative care for neurosurgical patients rarely includes structured psychological interventions. Moreover, no study to date in Iran has explored the comparative effects of CBT and MI on perceived stress and ICU duration in this high-risk group.

The current study addresses this gap by evaluating a CBT-based intervention's impact on perioperative stress reduction and ICU duration in neurosurgical patients.

MATERIALS AND METHODS

Study Design and Participants

This study was conducted using a quasi-experimental design with a pretest-posttest approach and control group. The research aimed to assess the effectiveness of CBT on reducing perceived stress and ICU stay in patients undergoing neurosurgical procedures. The study population consisted of 80 adult patients scheduled for elective brain surgery at Shohadaye Tajrish Hospital in Tehran, Iran, between 2020 and 2022. Patients were recruited through purposive sampling and subsequently assigned to either the intervention or control group using simple randomization.

Inclusion criteria included being a candidate for elective neurosurgical intervention (e.g., brain tumor resection), aged between 40 and 90 years, possessing adequate cognitive and communicative capacity to participate in psychological sessions, and providing written informed consent. Patients with severe psychiatric disorders (e.g., schizophrenia, active suicidality), major cognitive impairment, or those undergoing emergency surgery were excluded.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.RETECH.REC.1399.368). All participants were informed of their rights, and confidentiality was maintained throughout the study.

Intervention

The intervention group participated in a structured CBT program comprising 15 individual sessions administered before and after surgery. The content of the sessions was based on Miller's CBT protocol (11) and was tailored to address surgery-related stress. Sessions were conducted by trained clinical psychologists and focused on helping patients identify and challenge irrational thoughts, reframe catastrophic beliefs about surgery and ICU care, and develop adaptive coping strategies. Additionally, patients were taught behavioral techniques such as relaxation training, cognitive restructuring, and problem-solving skills to enhance their emotional resilience. The program also introduced education about the surgical process, expected side effects, hospitalization, and discharge planning to enhance cognitive preparedness and reduce uncertainty-related stress.

Both intervention and control groups received routine preoperative education and standard neurosurgical care. However, only the intervention group received the CBT sessions.

Measurements

All participants completed the Perceived Stress Scale (PSS) developed by Cohen et al. (4) before the first session and again following the last session, which was conducted after surgery and before hospital discharge. The CBT sessions were delivered face-to-face in a quiet clinical setting within the hospital, with each session lasting approximately 60 minutes.

In addition to psychological outcomes, clinical data were collected, including demographic variables (age, gender, education, occupation), type of neurosurgical procedure, ICU length of stay (in days), and comorbid conditions. All patients underwent standard preoperative assessments, including neurological examination, MRI imaging, EEG or EMG if indicated, and routine laboratory tests.

Data Analysis

Statistical analysis was performed using SPSS software (version 26.0). Descriptive statistics were used to summarize baseline characteristics. Chi-square tests were employed to compare categorical variables between groups, while independent and paired t-tests assessed differences in stress scores before and after the intervention. The Kolmogorov–Smirnov test was used to confirm the normality of data distributions. Analysis of covariance (ANCOVA) was used to control for baseline stress scores when evaluating post-intervention differences between groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Sample Characteristics

A total of 80 patients undergoing elective neurosurgical procedures were enrolled and randomly allocated into two groups: an intervention group receiving CBT (n=40), and a control group receiving standard care (n=40). Baseline demographic and clinical variables, including age, gender, education level, occupation, and symptoms, showed no statistically significant differences between the two groups, confirming their comparability (Table 1).

Table 1. Comparison of baseline demographic and clinical variables between control and CBT groups (n = 80).

Variable	Control Group	CBT Group	p-value
Age (mean ± SD)	61.73±12.42	63.08±12.22	0.626
Gender (Male)	20 (50%)	20 (50%)	1
Education (Primary)	2 (5%)	7 (17.5%)	
Education (Secondary)	4 (10%)	8 (20%)	
Education (Diploma)	11 (27.5%)	6 (15%)	
Education (Advanced Diploma)	2 (5%)	2 (5%)	0.343
Education (Bachelor)	14 (35%)	13 (32.5%)	
Education (Master)	3 (7.5%)	1 (2.5)	
Education (Doctorate)	4 (10%)	3 (7.5%)	
Occupation (Housewife)	8 (20%)	9 (22.5%)	
Occupation (Self-employed)	9 (22.5%)	9 (22.5%)	
Occupation (Employed)	8 (20%)	6 (15%)	
Occupation (Teacher)	2 (5%)	4 (10%)	
Occupation (Engineer)	4 (10%)	5 (12.5%)	0.894
Occupation (Medical Staff)	4 (10%)	2 (5%)	
Occupation (Pharmacist)	1 (2.5%)	0 (0%)	
Occupation (Retired)	4 (10%)	5 (12.5%)	
Headache	24 (60%)	23 (57.5%)	0.941
Neck Pain	25 (62.5%)	28 70%)	0.251
Back Pain	11 (27.5%)	11 (27.5%)	0.176
Radicular Pain	17 (42.5%)	19 (47.5)	0.653
Seizure History	15 (37.5%)	16 (40%)	0.818
Diagnosis (Lumbar Spinal Stenosis)	10 (25%)	11 (27.5%)	
Diagnosis (Cervical Spinal Stenosis)	11 (27.5%)	11 (27.5%)	0.790
Diagnosis (Brain Tumor)	18 (45%)	18 (45%)	
Diagnosis (Discopathy)	1 (2.5%)	0 (0%)	

The mean age in the control group was 61.73 years (SD=12.42), and 63.08 years (SD=12.22) in the CBT group (p=0.626). Gender distribution was also similar, with males comprising 50% in both groups (p=1.00). Educational background ranged from primary to doctoral levels, but the chi-square test indicated no significant difference in education distribution between the groups (p=0.343). Additionally, baseline clinical indicators such as headache, neck pain, seizure history, and diagnostic classifications were statistically equivalent across groups, further supporting baseline homogeneity.

Perceived Stress

Perceived stress was assessed using the Perceived Stress Scale (PSS) both before and after surgery in both groups. At baseline, the mean PSS score was 78.50 (SD=3.69) in the control group and 79.88 (SD=2.09) in the CBT group. The difference between groups was not statistically significant (p>0.05), indicating comparable initial stress levels. After the intervention, the CBT group showed a significant reduction in perceived stress, with a mean post-surgery score of 51.88 (SD=2.61), compared to 68.97 (SD=4.37) in the control group. This difference was statistically significant (p<0.001), confirmed by independent t-tests. Paired t-tests within each group also revealed significant reductions in perceived stress after surgery (CBT: t=93.46, p<0.001; Control: t=26.73, p<0.001), although the extent of change was much greater in the CBT group. Additionally, analysis of covariance (ANCOVA), controlling for baseline stress scores, showed a significant effect of the CBT intervention on postoperative stress levels (p<0.001), reinforcing the effectiveness of the CBT protocol.

These results are visually summarized in Figure 1, which depicts pre- and post-intervention stress scores for each group, highlighting the superior stress reduction achieved by the CBT group.

Length of ICU Stay

The number of days spent in the ICU following surgery was also significantly reduced in the CBT group. Patients in the intervention group had a mean ICU stay of 3.2 days (range: 2–7), whereas those in the control group had a mean stay of 4.6 days (range: 3–6). Chi-square analysis revealed a statistically significant difference in ICU length of stay between the two groups (p = 0.049), indicating that the CBT intervention was associated with shorter ICU hospitalization.

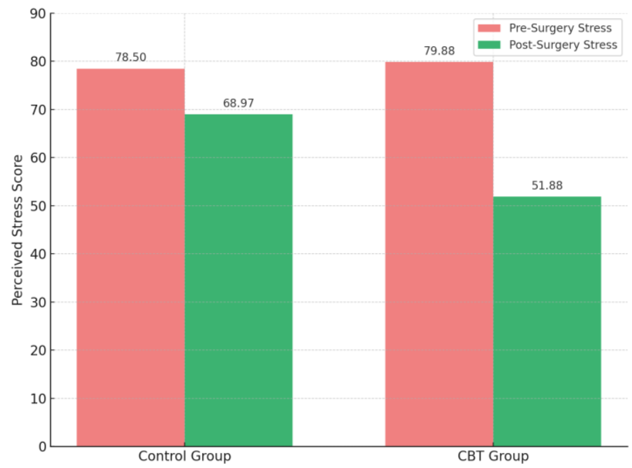

Figure 1. Mean perceived stress scores before and after surgery in the control and CBT groups. While both groups showed a reduction in stress levels postoperatively, the CBT group experienced a significantly greater decrease, indicating the effectiveness of the psychological intervention

DISCUSSION

The present study demonstrates that a structured CBT intervention significantly reduced perioperative perceived stress and shortened ICU stay duration among neurosurgical patients. This aligns strongly with prior research showing beneficial effects of psychological preparation on surgical outcomes.

Consistent with our findings, Yang et al. reported that preoperative computer-assisted CBT (cCBT) significantly reduced perioperative anxiety and cortisol levels in patients undergoing functional endoscopic sinus surgery (8). Published trials showing cCBT also decreased systolic and diastolic blood pressure and heart rate preoperatively (14). These physiological stress buffer effects help explain not only subjective relief but also tangible recovery benefits. Moreover, a randomized trial in coronary artery bypass patients found that brief perioperative CBT significantly reduced preoperative anxiety, depression, and hospital stay, and improved quality of life (15). These findings echo our results on stress reduction and reduced ICU stay.

Systematic reviews of psychological interventions in surgery broadly support these effects. One comprehensive review concluded that perioperative CBT and narrative medicine approaches consistently reduce hospital length of stay, postoperative pain, and pharmacological requirements (14). Neuro-immunological mechanisms were proposed, with psychological interventions influencing inflammatory markers, immune function, and neuroendocrine stress responses. Given our reported reduction in ICU days, these physiological pathways likely played a role.

In neurosurgery, perioperative stress has unique implications. Not only does stress impair systemic recovery, but it may also exacerbate neuroinflammation, impair neuroplasticity, and worsen neurological outcomes (2). Multidisciplinary perioperative pathways in skull-base surgery have reduced ICU stay by about half a day, suggesting ICU workflow optimizations, education, and rehabilitation reduce hospitalization (16). Our study indicates that CBT offers additional, patient-level psychological resilience that may augment such protocols from within the patient's cognitive coping framework.

Beyond CBT, Motivational Interviewing (MI)—though not the direct focus of this intervention—merits discussion as a potential adjunct. MI has proven effective in various postoperative and chronic disease contexts by enhancing patient motivation for rehabilitation and managing emotional readiness (12). Indeed, studies of MI within Enhanced Recovery After Surgery (ERAS) frameworks have shown improved mobilization and shorter hospital stays [3]. Future research should explore integrating MI with CBT, particularly in neurosurgical populations, to bolster coping and engagement.

Despite the strengths of this study—including randomization, validated psychometric assessment, and clinically meaningful outcomes—there are limitations. The quasi-experimental sample size limits statistical power to detect differences in rare postoperative complications. We also lacked longitudinal follow-up to assess long-term cognitive and psychological outcomes like post-intensive care syndrome (PICS). Future research should explore the combined physiological-psychological pathways of perioperative interventions, possibly integrating biomarkers such as cortisol or inflammatory cytokines.

Overall, this study contributes to emerging evidence that perioperative psychological care should be a standard component of neurosurgical pathways. CBT not only alleviates perceived stress but also yields tangible reductions in ICU stay. Integrating structured psychological interventions alongside existing neurocritical protocols could support holistic recovery, optimize resource use, and improve patient outcomes in neurosurgery.

CONCLUSION

CBT significantly lowers perioperative stress and reduces ICU stay in neurosurgical patients. Incorporating mental health professionals into surgical teams can optimize recovery outcomes, reduce hospital burden, and support holistic care. Further large-scale studies are recommended to confirm these findings and expand their application to other surgical fields.

Acknowledgments

We extend our gratitude to the staff and clinicians of Shohadaye Tajrish Hospital and the Neurofunctional Research Center for their invaluable support.

REFERENCES

1. Larsen LT. Not merely the absence of disease: A genealogy of the WHO's positive health definition. ***History of the Human Sciences*** 2022;35(1):111-31.
2. Oteri V, Martinelli A, Crivellaro E, Gigli F. The impact of preoperative anxiety on patients undergoing brain surgery: a systematic review. ***Neurosurg Rev*** 2021;44(6):3047-3057.
3. Reza T, Grezenko H, Barker C, Bakht D, Faran N, Abdullah Yahya N, et al. Emotional Stress and Immune Response in

Surgery: A Psychoneuroimmunological Perspective. ***Cureus*** 2023;15(11):e48727.

4. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. ***J Health Soc Behav*** 1983;24(4):385-96.
5. Oteri V, Martinelli A, Crivellaro E, Gigli F. The impact of preoperative anxiety on patients undergoing brain surgery: a systematic review. ***Neurosurg Rev*** 2021;44(6):3047-3057.
6. Balta MG, Karaman S, Karaman T, Tapar H, Dogru S, Suren M. The effect of preoperative anxiety and depression on postoperative recovery quality. ***Medicine Science*** 2022;11:1227-33.
7. Baker AW, Skolnik AM, Park JM, Sprich SE, Wilhelm S. Basic Principles and Practice of Cognitive-Behavioral Therapy. In: The Massachusetts General Hospital Handbook of Cognitive Behavioral Therapy. Cham: Springer International Publishing 2023: pp. 7-17.
8. Yang Y, Li Y, Zhang H, Xu Y, Wang B. The efficacy of computer-assisted cognitive behavioral therapy (cCBT) on psychobiological responses and perioperative outcomes in patients undergoing functional endoscopic sinus surgery: a randomized controlled trial. ***Perioper Med (Lond)*** 2021;10(1):28.
9. Buvanendran A, Sremac AC, Merriman PA, Della Valle CJ, Burns JW, McCarthy RJ. Preoperative cognitive-behavioral therapy for reducing pain catastrophizing and improving pain outcomes after total knee replacement: a randomized clinical trial. ***Reg Anesth Pain Med*** 2021;46(4):313-321.
10. Salimpour M, Dehghan M, Ahmadi A, Azzizadeh Forouzi M, Roy C, Zakeri MA, et al. Effectiveness of cognitive-behavioral therapy on perceived stress among patients undergoing percutaneous coronary intervention: A randomized controlled trial. ***Perspect Psychiatr Care*** 2022;58(4):2962-2969.
11. Miller WR, Rollnick S. Motivational interviewing: Helping people change. Guilford press; 2012.
12. Zhang BR, Yang X. Motivational interviewing in postoperative rehabilitation and chronic disease management: Current findings and future research directions. ***World J Psychiatry*** 2025;15(1):102737.
13. Wiesenberger R, Müller J, Kaufmann M, Weiß C, Ghezel-Ahmadi D, Hardt J, et al. Influence of motivational interviewing on postoperative mobilization in the enhanced recovery after surgery (ERAS®) pathway in elective colorectal surgery - a randomized patient-blinded pilot study. ***Langenbecks Arch Surg*** 2024;409(1):134.
14. Lanini I, Amass T, Calabrisotto CS, Fabbri S, Falsini S, Adembri C, et al. The influence of psychological interventions on surgical outcomes: a systematic review. ***J Anesth Analg Crit Care*** 2022;2(1):31.
15. Dao TK, Youssef NA, Armsworth M, Wear E, Papathopoulos KN, Gopaldas R. Randomized controlled trial of brief cognitive behavioral intervention for depression and anxiety symptoms preoperatively in patients undergoing coronary artery bypass graft surgery. ***J Thorac Cardiovasc Surg*** 2011;142(3):e109-15.
16. Yawn RJ, Nassiri AM, Harris JE, Manzoor NF, Godil S, Haynes DS, et al. Reducing ICU Length of Stay: The Impact of a Multidisciplinary Perioperative Pathway in Vestibular Schwannoma. ***J Neurol Surg B Skull Base*** 2021;83(Suppl 2):e7-e14.