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Effects of whole-course case management in combination with mind mapping on neurological functions and prognosis of patients receiving hematoma evacuation for hypertensive cerebral hemorrhage

Účinky léčby v průběhu celého onemocnění v kombinaci s tvorbou myšlenkových map na neurologické funkce a prognózu pacientů podstupujících evakuaci hematomu při hypertenzním krvácení do mozku

Abstract

Background: Hypertensive cerebral hemorrhage is a common cerebrovascular disease. *Aim:* This study aimed to assess the effects of whole-course case management in combination with mind mapping on the neurological functions and prognosis of patients receiving hematoma evacuation for hypertensive cerebral hemorrhage. *Methods:* A total of 130 patients who underwent hematoma evacuation for hypertensive cerebral hemorrhage were retrospectively included and assigned into a case group (N = 66, given whole-course case management plus mind mapping) and a conventional group (N = 64, given conventional nursing). Neurological functions, activities of daily living, exercise ability, blood pressures, mental state, and complications were compared between the two groups. Categorical variables were expressed as absolute numbers and percentages, and compared between groups using the Chi-square test. Normally distributed data were expressed as (mean ± standard deviation) and subjected to the t-test. *Results:* After intervention, both groups showed significant improvements in Fugl-Meyer Assessment scores, with the case group demonstrating significantly higher scores than the conventional group ($P < 0.05$). The positive affect score significantly increased, whereas the negative affect score significantly decreased in both groups, and the case group displayed significant increases in the positive affect score and reductions in the negative affect score in comparison to the conventional group ($P < 0.05$). The total incidence rate of complications was significantly lower in the case group than in the conventional group (7.58 vs. 21.88%; $P < 0.05$). *Conclusion:* The nursing model combining whole-course case management with mind mapping is capable of boosting the recovery of neurological functions, enhancing the activities of daily living and exercise ability, and stabilizing the blood pressure in patients with hypertensive cerebral hemorrhage receiving hematoma evacuation.

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Souhrn

Východiska: Hypertenzní krvácení do mozku je časté cerebrovaskulární onemocnění. *Cíl:* Cílem této studie bylo posoudit vliv kombinace péče o pacienta v průběhu celého onemocnění a tvorby myšlenkových map na neurologické funkce a prognózu pacientů, kteří podstoupili evakuaci hematomu v důsledku hypertenzního krvácení do mozku. *Metody:* Do studie bylo retrospektivně zařazeno 130 pacientů, kteří podstoupili evakuaci hematomu pro hypertenzní krvácení do mozku, přičemž byla vytvořena skupina s komplexní péčí (n = 66, pacientům byla poskytnuta léčba v průběhu celého onemocnění v kombinaci s tvorbou myšlenkových map) a skupina s konvenční léčbou (n = 64). Mezi oběma skupinami byly porovnány neurologické funkce, běžné denní aktivity, pohybové schopnosti, krevní tlak, duševní stav a komplikace. Kategorické proměnné byly vyjádřeny jako absolutní počty a procenta a porovnány mezi skupinami pomocí Chi-kvadrát testu. Normálně rozložená data byla vyjádřena jako průměr ± směrodatná odchylka a podrobena t-testu. *Výsledky:* Po intervenci vykazovaly obě skupiny významné zlepšení ve skóre Fugl-Meyer Assessment, přičemž skupina s komplexní péčí vykazovala významně vyšší skóre než skupina s konvenční léčbou ($p < 0,05$). V obou skupinách došlo k významnému zvýšení skóre pozitivních emocí a významnému snížení skóre negativních emocí, přičemž zvýšení skóre pozitivních emocí a snížení skóre negativních emocí bylo u skupiny s komplexní péčí v porovnání se skupinou s konvenční léčbou významné ($p < 0,05$). Celkový výskyt komplikací byl ve skupině s komplexní péčí významně nižší než ve skupině s konvenční léčbou (7,58 vs. 21,88 %; $p < 0,05$). *Závěr:* Při modelu péče kombinujícím léčbu v průběhu celého onemocnění a tvorbu duševních map je u pacientů s hypertenzním krvácením do mozku, kteří podstoupili evakuaci hematomu, možné podpořit obnovení neurologických funkcí, zlepšení každodenních aktivit a pohybových schopností a stabilizaci krevního tlaku.

Introduction

Hypertensive cerebral hemorrhage is defined as vascular rupture due to reduced tension of the blood vessel wall, which is induced by long-term arterial hypertension giving rise to hyaline degeneration and fibrinoid necrosis of small arterioles in the brain [1]. It is mainly manifested as vomiting, headache, hemiplegia, and clouding of consciousness. In severe cases, cognitive and limb dysfunction may occur, endangering the lives of patients [2]. Globally, there were approximately 3.444 million new intracerebral hemorrhage cases in 2021, corresponding to an age-standardized prevalence rate of 40.8 per 100,000 and an age-standardized mortality rate of 39.1 per 100,000, both showing substantial declines since 1990 [3]. Regionally, the highest intracerebral hemorrhage prevalence rates were observed in Central Asia, Oceania, and Southeast Asia, whereas Western Europe, Australasia, and high-income North America had markedly lower rates. Notably, intracerebral hemorrhage accounted for roughly 28.8% of all new stroke events worldwide in 2021 [4]. In the Czech Republic, hospitalized stroke incidence in 2011 was 241 per 100,000 individuals, with intracerebral hemorrhage accounting for 29.5 per 100,000 (crude rate) or 16.7 per 100,000 when age standardized to the WHO 2000 population. Hemorrhagic strokes comprised of about 18% of all strokes [5].

As one of the main therapeutic approaches for hypertensive cerebral hemorrhage, hematoma evacuation is capable of removing the hematoma at lesion sites, effectively controlling the condition and reducing the mortality rate, which, however, easily leads to complications such as motor dysfunction postoperatively [6]. Hence, providing comprehensive and effective nursing is essential for the treatment and recovery of patients. However, conventional nursing fails to meet patients' complex post-surgical needs.

Mind mapping nursing is aimed at clearly presenting complicated nursing procedures and key links in graphics, which is conducive to the communication of nursing teams and enhances the quality of nursing [7]. In patients with severe brain injury, goal oriented mind mapping nursing can significantly shorten hospital stays, reduce complications, and enhance neurological and motor recovery by organizing complex care elements into clear visual workflows [8]. Whole-course case management embodies an integrative, patient-centered model that aligns with evidence-based medicine principles. It is characterized by integrality and sustainability, takes "meeting the individual needs of patients" as its service tenet, and offers patients comprehensive nursing services in an all-round collaborative management mode [9]. Case management may improve the prognosis of patients with diabetes mellitus [10]. To date, the combined application of mind mapping and whole-course case management in the context of hematoma evacuation in patients with hypertensive cerebral hemorrhage remains underexplored.

Given this, the present study was designed to investigate the effects of whole-course case management plus mind mapping on the neurological functions and prognosis of patients receiving hematoma evacuation for hypertensive cerebral hemorrhage.

Materials and methods

Subjects

In this retrospective observational study, a total of 130 consecutive patients who underwent hematoma evacuation for hypertensive cerebral hemorrhage in West China Hospital of Sichuan University between January 2023 and December 2024 were included. Group allocation was based solely on retrospective review of nursing records, and no prospective randomization or allocation was involved. According to the nursing models they had received during hospitalization, the patients were categorized into two groups: a case group (N = 66), who received whole-course case management combined with mind mapping nursing, and a conventional group (N = 64), who received conventional nursing.

The following inclusion criteria were used:

1) patients who met the diagnostic criteria for hypertensive cerebral hemorrhage [11], were diagnosed with hypertensive cerebral hemorrhage based on imaging results, and underwent hematoma evacuation;
2) those with hematoma volume ≥ 30 mL;
3) those not receiving other surgical treatment;
4) those without cognitive dysfunction and with good compliance;
5) those with complete clinical data.

Exclusion criteria are listed below:

1) patients with cerebral hemorrhage caused by brain tumors;
2) those with contraindications to surgery (including severe comorbidities such as

Tab. 1. Comparison of nursing interventions between conventional and case groups across perioperative phases.

Nursing Phase	Conventional group	Case group
Preoperative	• comprehensive patient assessment • establish venous access • prepare instruments and drugs	• same as conventional group + preoperative mind map + structured psychological support
Intraoperative	• select appropriate anesthesia • monitor vital signs (blood pressure, heart rate, respiration) • maintain body temperature	• same as conventional group + cognitive behavior therapy to relieve anxiety + adjust temperature and relative humidity of the operating room
Postoperative	• monitor vital signs and drainage • encourage rehab after ilitation stabilization	• same as conventional group + postoperative mind map + dietitian-led nutrition + psychological counseling + guided rehab ilitation by therapist

uncontrolled cardiac or respiratory failure, irreversible coma – the Glasgow Coma Scale score ≤ 5, and pregnancy);
3) those with coagulation disorders;
4) those with other malignancies;
5) those with severe mental illness.

Methods

Conventional nursing was implemented in the conventional group. In brief, the patients received close monitoring of vital signs, along with targeted respiratory and medication care. Family members were educated on disease-related precautions. Additionally, the patients were guided on proper dietary habits, appropriate exercise, and symptomatic treatment strategies for managing complications.

In the case group, the nursing model of whole-course case management plus mind mapping was employed (Tab. 1). A multidisciplinary intervention team was established, comprising of one attending physician, two case managers, one dietitian, one psychological counselor, and one rehabilitation therapist. Nursing interventions were delivered across three phases:

1) Preoperative nursing:
   a. A comprehensive assessment was conducted, covering medical history, presenting symptoms, and clinical signs, based on which an individualized nursing plan was developed.
   b. Intravenous access was established, and all necessary surgical instruments and medications were prepared.
   c. Case managers created a preoperative mind map highlighting key nursing tasks, including baseline patient data, condition assessment, and psychological care. This enabled clear communication among staff and ensured smooth implementation of preoperative nursing.

2) Intraoperative nursing:
   a. Anesthesia nursing was provided. Appropriate anesthesia types, such as intravenous general anesthesia, inhalational anesthesia, or local anesthesia, were selected based on the patient's condition and surgical requirements. In addition, preoperative cognitive-behavioral intervention was implemented to relieve anxiety, depression, and emotional distress.
   b. Vital signs of patients, including blood pressure, heart rate, and respiration, were closely observed.
   c. The temperature and relative humidity of the operating room were kept at 24–26°C and 40–60%, respectively, the circulating water blanket was used to keep the patients warm, and intravenous infusion liquid was preheated to 37 °C using a thermostat.

3) Postoperative nursing:
   a. Case managers drew a postoperative nursing mind map covering surgery, dietary nursing, and psychological nursing.
   b. After surgery, the patients were instructed to remain in a supine position without a pillow, with the head turned towards the healthy side and the bed was raised by 15–30°, which was conducive to hematoma drainage and venous return.
   c. Vital signs of patients were closely monitored, and any observed abnormalities were immediately reported to the physician, followed by treatment.
   d. The respiratory tract was kept unobstructed, sputum was aspirated in time, and the drainage tube was properly fixed and kept unobstructed. In addition, the drainage (color of the drainage tube and the amount of drainage) was observed and recorded. In the case of abnormalities, the physician was notified immediately, and corresponding measures were taken.
   e. The dietitian offered the patients foods rich in protein and vitamins and low in fats postoperatively, such as fish, lean meat, eggs, vegetables, and fruits, while high-fat foods, such as animal offal and animal oil, were forbidden. The patients were asked to drink more water appropriately to prevent constipation. Additionally, in patients with disturbance of consciousness, a nasal feeding tube diet was given, the mouth was kept clean, and aspiration was prevented.
   f. The psychological counselor assessed the psychological state, provided targeted psychological counseling, offered them comfort and encouragement, helped them understand the disease, and established their confidence in overcoming the disease.
   g. After vital signs became stable, the rehabilitation therapist guided them

Tab. 2. Baseline clinical data (N [%], [$\bar{x} \pm s$]).

Indicator	Case group (N = 66)	Conventional group (N = 64)	t/χ^2	P
sex				
male	42 (63.64)	34 (53.12)	1.478	0.224
female	24 (36.36)	30 (46.88)		
age (years)	61.31 ± 4.39	62.37 ± 4.45	1.367	0.174
duration of arterial hypertension (years)	7.35 ± 0.35	7.41 ± 0.33	1.005	0.317
hemorrhage site	13 (19.70)	12 (18.75)	0.257	0.968
lobar	15 (22.73)	14 (21.88)		
cerebellum	22 (33.33)	20 (31.25)		
basal ganglia	16 (24.24)	18 (28.12)		
thalamus	13 (19.70)	12 (18.75)	0.257	0.968
Glasgow Coma Scale score on admission (points)	9.16 ± 0.48	9.18 ± 0.51	0.230	0.818

N – number

to perform active exercises in bed, and the exercises initially lasted for 5–10 min/session and then gradually increased to 30–45 min/session 2–3 times/day. During exercise, excessive breath holding was avoided. Moreover, the patients had training on daily living skills, such as putting on and taking off clothes, eating, washing their face, brushing teeth, and combing their hair. Furthermore, physical therapy, occupational therapy, speech training, cognitive rehabilitation, and other rehabilitation training were offered based on specific situation.

Evaluation of outcomes

Outcome data were collected by two independent researchers blinded to the group assignment, based on pre- and post-intervention documentation in the charts. Discrepancies were resolved through discussion with a third evaluator.

Neurological functions: The National Institutes of Health Stroke Scale (NIHSS) was employed to evaluate the neurological functions before and after intervention [12]. The NIHSS comprised of 11 items, including level of consciousness, gaze, visual field, facial paralysis, sensation, and dysarthria. The total score is 0–42 points, and higher scores suggestes more serious neurological deficits.

Activities of daily living: The activities of daily living were assessed before and after intervention using the Modified Barthel Index (MBI) composed of 10 items including eating [13], bathing, dressing, and controlling urine and bowel movements, with a total score of 100 points. A higher score suggestes better activities of daily living.

Exercise ability: The Fugl-Meyer Assessment (FMA) was adopted to assess the exercise ability before and after intervention [14]. FMA consisted of 5 dimensions: movement, sensation, balance, range of motion, and pain, with 66 points for upper limbs and 34 points for lower limbs. A lower score means worse exercise ability.

Blood pressure: Systolic and diastolic blood pressures (in mmHg) were measured before and after intervention using the HEM-7130 automated electronic sphygmomanometer (Omron, Kyoto, Japan). Measurements were performed on the same upper limb in the morning at rest for 3 consecutive days, and the average value was recorded as the final result.

Mental state: Mental state was assessed before and after intervention using the Positive Affect and Negative Affect Scale (PANAS) [15]. It comprised of a positive affect scale and a negative affect scale. The 5-point scoring method was adopted, and higher scores denotes a greater level of that type of mood.

Complications: The incidence rate of complications, including pulmonary infection, urinary tract infection, bedsores, recurrence of cerebral hemorrhage, and joint stiffness, was recorded in both groups after intervention. Incidence rate of complications = number of cases with complications/number of total cases × 100%.

Statistical analysis

Statistical analysis was conducted using SPSS 26.0 software (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as absolute numbers and percentages (n [%]), and compared between groups using the Chi-square test. Continuous variables were first tested for normality using the Shapiro-Wilk test. Normally distributed data were expressed as (mean ± standard deviation) and subjected to the t-test. All tests were two-tailed, and a P-value of < 0.05 was considered statistically significant.

Results

Baseline clinical data

In the case group, there were 42 males (63.64%) and 24 females (36.36%), with a mean age of 61.31 ± 4.39 years. In the conventional group, there were 34 males (53.13%) and 30 females (46.88%), with a mean age of 62.37 ± 4.45 years. The average duration of arterial hypertension was 7.35 ± 0.35 years in the case group and 7.41 ± 0.33 years in the conventional group. Hemorrhage sites were similarly distributed between the two groups, including lobar, cerebellar, basal ganglia, and thalamic regions. The Glasgow Coma Scale score on admission was 9.16 ± 0.48 points in the case group and 9.18 ± 0.51 points in the conventional group. There were no significant differences in any of these base-

Tab. 3. NIHSS and MBI scores (point, $\bar{x} \pm s$).

Group	N	NIHSS score		MBI score	
		before intervention	after intervention	before intervention	after intervention
case	66	25.34 ± 3.73	12.41 ± 2.69*	47.92 ± 4.71	83.29 ± 6.77*
conventional	64	25.82 ± 3.72	17.83 ± 2.32*	47.56 ± 4.40	68.62 ± 4.99*
t		0.735	12.286	0.450	14.029
P		0.464	< 0.001	0.654	< 0.001

*P < 0.05 vs. the same group before intervention
MBI – Modified Barthel Index; N – number; NIHSS – National Institutes of Health Stroke Scale

Tab. 4. FMA scores (point, $\bar{x} \pm s$).

Group	N	Upper limb score		Lower limb score	
		before intervention	after intervention	before intervention	after intervention
case	66	34.48 ± 1.29	43.51 ± 1.63*	24.39 ± 1.66	30.35 ± 1.50*
conventional	64	34.51 ± 1.48	38.47 ± 1.32*	24.29 ± 1.64	24.35 ± 1.49*
t		0.123	19.339	0.345	22.876
P		0.902	< 0.001	0.730	< 0.001

*P < 0.05 vs. the same group before intervention
FMA – Fugl-Meyer Assessment; N – number

Tab. 5. Blood pressure (mmHg, $\bar{x} \pm s$).

Group	N	Systolic blood pressure		Diastolic blood pressure	
		before intervention	after intervention	before intervention	after intervention
case	66	163.85 ± 9.44	138.36 ± 3.98*	101.70 ± 4.58	89.65 ± 2.42*
conventional	64	164.26 ± 9.63	157.92 ± 4.44*	101.84 ± 4.56	95.82 ± 2.39*
t		0.245	26.467	0.175	14.622
P		0.807	< 0.001	0.862	< 0.001

*P < 0.05 vs. the same group before intervention
N – number

line characteristics between the two groups (P > 0.05) (Tab. 2).

NIHSS and MBI scores

The NIHSS and MBI scores were comparable between the two groups before intervention (P > 0.05). After intervention, the NIHSS score showed a downward trend, whereas the MBI score displayed an upward trend in both groups, and the case group exhibited a significantly lower NIHSS score and a significantly higher MBI score than the conventional group (P < 0.05) (Tab. 3).

FMA scores

Before intervention, no significant difference was observed in the FMA score between the two groups (P > 0.05). Following intervention, the scores of upper limbs and lower limbs significantly rose in both groups, and they were significantly higher in the case group than in the conventional group (P < 0.05) (Tab. 4).

Blood pressures

There were no significant differences in blood pressure values between the two groups before intervention (P > 0.05). After intervention, drops were found in the systolic and diastolic blood pressures in the two groups, and the case group had significantly decreases in comparison with the conventional group (P < 0.05) (Tab. 5).

PANAS scores

Before intervention, the PANAS score showed no significant difference between the two groups (P > 0.05). After intervention, the positive affect score significantly increased in both groups, and it was significantly higher in the case group than in the conventional group. The negative affect score was sig-

Tab. 6. PANAS scores (points, $\bar{x} \pm s$).

Group	N	Positive affect score		Negative affect score	
		before intervention	after intervention	before intervention	after intervention
case	66	23.67 ± 3.34	33.60 ± 3.29*	22.62 ± 3.51	14.45 ± 3.55*
conventional	64	23.22 ± 3.29	27.38 ± 3.24*	22.22 ± 3.27	19.30 ± 2.46*
t		0.774	10.858	0.672	9.028
P		0.441	< 0.001	0.503	< 0.001

*P < 0.05 vs. the same group before intervention
N – number; PANAS – Positive Affect and Negative Affect Scale

Tab. 7. Complications (N [%]).

Group	N	Urinary tract infection	Bedsore	Pulmonary infection	Recurrence of cerebral hemorrhage	Joint stiffness	Total incidence rate
case	66	2 (3.03)	1 (1.52)	1 (1.52)	0 (0.00)	1 (1.52)	5 (7.58)
conventional	64	3 (4.69)	3 (4.69)	2 (3.13)	1 (1.56)	5 (7.81)	14 (21.88)
χ^2							5.324
P							0.021

N – number

nificantly lowered in the two groups, and it was significantly lower in the case group than in the conventional group (P < 0.05) (Tab. 6).

Complications

The total incidence rate of complications was 7.58% in the case group, which was significantly lower than that in the conventional group (21.88%) (Tab. 7).

Discussion

Despite hematoma evacuation being an effective surgical intervention for hypertensive intracerebral hemorrhage, many patients continue to face poor neurological recovery due to secondary injury, suboptimal rehabilitation, and insufficient postoperative support [16]. This suggests the crucial role of enhanced nursing strategies to bridge this gap. In our study, the combined application of whole-course case management and mind mapping showed significant benefits in neurological functions, motor recovery, daily living activities, emotional well being, and complication reduction.

In the present study, the case group had a significantly lower NIHSS score and higher MBI and FMA scores than the conventional group, indicating enhanced neurological functions, activities of daily living, and motor recovery. These results are consistent with previous findings. For example, Zhang et al. demonstrated that mind mapping nursing boosted the recovery of nerve and limb motor function and raised the quality of life in patients with brain injuries [8]. Similarly, Jin et al. reported that stroke patients receiving structured nursing pathways based on case management achieved better rehabilitation outcomes than conventional care [17]. Our results verify these findings and extend them by integrating both mind mapping and whole-course case management, which together provided a more intuitive and goal-directed rehabilitation plan. The improved outcomes may be attributed to the decomposition of complex rehabilitation goals into manageable sub-goals using mind maps, coupled with timely monitoring and personalized interventions through case management. Moreover, physical and occupational therapies were delivered based on individualized needs, further promoting recovery. Early and personalized rehabilitation is key to maximizing functional outcomes after cerebral hemorrhage [18].

In terms of blood pressure management, our study found that the case group had significantly lower systolic and diastolic blood pressures post-intervention. This suggests that whole-course case management plus mind mapping supports more stable hemodynamic control. Similar findings were reported by Li et al. [19], who found that collaborative multidisciplinary nursing reduced blood pressure fluctuations in patients with hypertensive cerebral hemorrhage. Our study further suggests that the use of visual mind maps for medication reminders and education may enhance medication adherence and self-monitoring behavior, contributing to this stability. Additionally, mental status also improved significantly in the case group. Higher positive affect and lower negative affect scores suggest better emotional adjustment. These results are in line with Tan et al. [20] and are further supported by Song et al. [21] who found that nursing strategies incorporating psychological monitoring and targeted interventions led to better mood regulation in stroke patients. In our study, regular psychological assessments and the use of psychological mind maps likely facilitated early detection and timely interventions, such as relaxation the-

rapy or counseling, which contributed to improved emotional stability and rehabilitation motivation.

Furthermore, the case group had a significantly lower incidence rate of complications. This finding is consistent with the study by Zhang et al. [22], which reported that multidisciplinary nursing reduced postoperative complications in patients with hypertensive cerebral hemorrhage. The reduction of complications in our study may be due to early mobilization, patient education, timely detection of warning signs, and nutritional support, all of which were explicitly structured and monitored through the mind mapping tool and implemented by the multidisciplinary team.

Taken together, the results of this study highlight that whole-course case management combined with mind mapping enhances postoperative outcomes in patients undergoing hematoma evacuation for hypertensive cerebral hemorrhage. Compared with previous studies that focused solely on case management or mind mapping, our integrative approach achieved broader improvements in neurological recovery, blood pressure stability, mental well-being, and complication prevention.

Nevertheless, this single-center study also has some limitations. For instance, the sample size was small, which may affect the generalizability of the findings. In the future, multi-center clinical studies with a large sample size should be carried out to further validate and refine this integrative nursing model.

Conclusion

In conclusion, whole-course case management plus mind mapping nursing can facilitate the recovery of neurological functions, raise the activities of daily living and exercise ability, stabilize blood pressures, and lower the incidence rate of complications in patients undergoing hematoma evacuation for hypertensive cerebral hemorrhage.

Ethical principles

The entire study was conducted in accordance with the Helsinki Declaration of 1975 (as revised in 2004 and 2008). The present study was performed with approval from the West China Hospital of Sichuan University (NO. WC2022.301, date of approval: 5. 1. 2022).

Availability of data and materials

Data that support the findings of this study are available from the corresponding author upon reasonable request.

Authors' contributions

XC designed the study and supervised the study, LZ performed and analyzed the experiments, and WC drafted the paper.

Conflict of Interest

The authors report no potential conflicts of interest concerning drugs, products, or services used in the study.

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