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Original Article

Effect of pre-hospital early intervention combined with an in-hospital emergency model in the emergency care of patients with acute stroke

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Abstract: Objective: This study aimed to explore the effect of pre-hospital early intervention combined with an in-hospital emergency model in the emergency care of patients with acute stroke. Methods: Eighty-six patients with acute stroke treated in our hospital between December 2018 and January 2020 were enrolled prospectively and were divided into two groups according to the random number table method, with 43 cases in each group. The control group received conventional emergency mode care, while the study group received pre-hospital early intervention combined with an in-hospital emergency model. The success rate of successful resuscitation (CPR), resuscitation endpoints, complication rates, nursing satisfaction and changes in limb motor function (Fugl-Meyer score) and activity of daily living (ADL score) before and at 3 months after intervention were compared between the two groups. Results: The total success rate of rescue and nursing satisfaction were higher in the study group (93.02%, 97.77%) than in the control group (74.42%, 79.07%), while the complication rate in the study group (4.65%) was lower than that in the control group (20.93%). Time to resuscitation, time to thrombolytic therapy, time from admission to completion of imaging, and the length of hospital stay were shorter in the study group than in the control group ($P<0.05$). Compared with pre-intervention, Fugl-Meyer and ADL scores were increased in both groups and were higher in the study group ($P<0.05$). Conclusion: Pre-hospital early intervention combined with in-hospital emergency model in the first aid of patients with acute stroke can effectively improve the success rate of rescue, shorten the duration of rescue and length of hospital stay, reduce the incidence of complications, increase nursing satisfaction, and improve limb motor function and ADL.

Keywords: Acute stroke, pre-hospital early intervention, in-hospital emergency model, limb motor function, nursing satisfaction

Introduction

The elderly population continues to grow at an unprecedented rate, leading to an increasing number of patients with acute stroke in China, which not only seriously threatens the life and health of patients, but also brings a heavy burden to families and society [1]. Acute stroke is a common cerebrovascular disease with high incidence rate, and it is characterized by high disability, high lethality and high complication rates [2]. Patients with acute stroke may experience varying degrees of limb motor dysfunction, unconscious, vomiting and respiratory distress at the onset of stroke, which has a serious negative impact on patients' quality of life [3]. The key to emergency care for acute stroke is to shorten the time to rescue and give intravenous thrombolytic therapy as early as possible, but only a small number of patients have successfully received thrombolytic therapy due to the small time window [4]. The time assigned for each emergency session, such as pre-hospital rescue and in-hospital consultation, is long in

routine emergency care, which is not conducive to the treatment of acute stroke and affects patient prognosis [5]. Therefore, how to shorten the time to resuscitation is a challenge in the current nursing services.

Pre-hospital early intervention and in-hospital emergency models have been widely used in the nursing of patients with acute stroke, both of which can effectively shorten the time to rescue and improve the rescue effect, showing great advantages [6]. Sanello et al. [7] found that pre-hospital emergency care in patients with acute ischemic stroke can effectively shorten the time to rescue. A study by Jin [8] showed that an in-hospital integrated emergency care model can effectively shorten the time to intravenous thrombolysis and enhance the efficacy of rescue. However, there are few studies on the application of pre-hospital early intervention combined with an in-hospital emergency model in the emergency care of patients with acute stroke, which is the key point of this study.

Materials and methods

Clinical data

Eighty-six patients with acute stroke treated in our hospital between December 2018 and January 2020 were prospectively enrolled and were divided into two groups (N=43 for each group) according to a random number table method.

Selection criteria

Inclusion criteria: (1) those who met the diagnostic criteria for acute stroke [9] which was confirmed by cranial magnetic resonance imaging (MRI); (2) aged between 18 and 70 years; and (3) those with onset of action ≤6 h. This study was reviewed and approved by the ethics committee of Xingtai Medical College (No. NCT01593576). All patients or their families signed informed consent. Exclusion criteria: (1) those comorbid with other cerebrovascular lesions; (2) patients with intracranial tumors; (3) patients with coagulation dysfunction and hematologic disorders; (4) those comorbid with severe cardiac, hepatic, and renal abnormalities; and (5) those with poor compliance.

Methodology

Control group: The routine emergency mode was performed. The patients were treated by emergency ambulance crews on duty during transfer. Upon entering the hospital, the medical staff made a simple assessment of the patients' condition, accompanied the patients for imaging, and gave emergency measures such as regulation of blood pressure, reduction of intracranial pressure, thrombolytic therapy, *etc*., and then made an accurate assessment after the their conditions were stabilized.

S*tudy group:* Pre-hospital early intervention combined with an in-hospital emergency model was performed, where pre-hospital early intervention included: ① Early condition assessment. Upon receiving an emergency call, medical staff took the initiative to inquire about clinical symptoms and medical history, from which they made a preliminary assessment of suspected acute stroke, and arranged a professionally trained nurse to follow the ambulance to rescue the patient within 5 min. ② Telephone guidance. Before the ambulance arrived, family was guide to perform first aid by telephone, including elevating the patient's head (about 30°), placing a towel in the patient's mouth to avoid biting the tongue due to spasm. For patients who appeared to vomit, oral and nasal secretions were promptly cleaned up to avoid the occurrence of aspiration pneumonia. ③ On-site first aid. When the ambulance arrived, the stroke specialist nurse assessed the patient's condition by heart rhythm, blood pressure and clinical symptoms and medical history, and made a record. Keeping a patient's airways clean can effectively avoid deterioration of the condition and facilitate treatment. Nursing staff promptly removed the patient's secretions and gave aspiration treatment. In patients who developed glossocoma, the tongue was promptly pulled out using tongue forceps and a ventilation tube was given to help breathing. For patients with severe airway obstruction, tracheal intubation or tracheotomy may be performed as appropriate. Hypoxia has a serious impact on treatment and patient prognosis. Nursing staff promptly gave oxygen therapy (30%-40% and 4-6 L/min), and if the patient was breathing weakly, he or she may be given oxygen therapy by face mask. Rising

intracranial pressure can cause death in patients with acute stroke. The patient was given 20 mg of furosemide and 250 mL of 20% mannitol for treatment, while the changes in the patient's condition were closely monitored during the administration of the drug. Safe transport can effectively improve the success rate of patient rescue. During the transport, gentle movements were made to maintain smoothness, with the patient lying flat on his back and head tilted to one side. The visiting nurse reported the patient's background, condition, and symptoms to the Emergency Department of the hospital by telephone, and the hospital opened a green channel immediately after receiving the report, prepared items and drugs needed for emergency treatment, *etc*., and notified the Imaging Department to do relevant examinations. The in-hospital emergency model includes: ① Condition assessment and confirmation of diagnosis. After the ambulance arrived at the hospital, the medical personnel made a preliminary assessment of the patient's condition by convenient methods such as pupil observation and pain stimulation, and if the patient had abnormal pupil changes, *etc*., resuscitation was promptly carried and the diagnosis was confirmed as soon as possible. ② First aid measures. Patient's body temperature was regulated by subfreezing therapy and physical cooling. Doctors decided whether to give thrombolytic therapy to the patient. The physicians performed thrombolytic therapy by injecting 0.09 mg/kg intravenous alteplase (rt-PA, LGM Pharma, CAS: 105857-23-6) within 1 min, and the remaining rt-PA was administrated within 60 min. The dose did not exceed 0.9 mg/kg. The changes in the patient's vital signs were monitored and the physician was informed promptly if abnormalities were observed. After the operation, the patients were instructed to perform functional exercises of the limbs, while psychological guidance was given to the patients to alleviate the adverse emotions.

Outcome measurements

Resuscitation success rate: Patients were assessed within 48 h after admission, in which disappearance of clinical symptoms, stable vital signs and >90% reduction in neurological deficit score (NIHSS) were considered successful; disappearance of some symptoms, more stable vital signs and >45% but ≤90% reduction in NIHSS score were considered markedly improvement; disappearance of a few symptoms, basically stable vital signs and >18% but ≤45% reduction in NIHSS score were considered effective, and conditions not meeting the above criteria were considered ineffective. The success rate of rescue = (cases of success + markedly improvement + effective)/total cases.

Resuscitation parameters: Time to rescue, time to thrombolytic therapy, time from admission to completion of imaging, and the length of hospital stay were compared between the two groups.

Complications: The incidence of complications such as deep vein thrombosis, pulmonary infection, secondary epilepsy, and gastrointestinal bleeding was compared between the two groups.

Nursing satisfaction: Upon discharge, nursing satisfaction was assessed using our self-designed questionnaire, which was filled in by the patients and family members, covering quality of care, attitude, *etc*., ranging 0-50 points, including very satisfied (46-50 points), generally satisfied (41-45 points) and dissatisfied (0-40 points), and nursing satisfaction was the sum of very satisfied rate and general satisfaction.

Limb motor function and activity of daily living (ADL): The Fugl-Meyer motor function scale and the ADL scale were used to assess the limb motor function and ADL before and at 3 months after intervention, respectively, and a higher score represented better limb motor function and ADL.

Statistical analysis

Using SPSS 23.0 software and Graphpad Prism 8.1, the count data (resuscitation success rate, complications, and nursing satisfaction) were expressed as percentages and compared using the χ^2 test, and the measurement data (resuscitation endpoints, Fugl-Meyer, and ADL scores) were expressed as ($\bar{x}\pm S$) and examined using the independent *t* test between groups and the paired *t* test within groups. $P<0.05$ indicated significant difference.

Results

Baseline data

The differences in gender, age, time from onset to admission, NIHSS score, and Glasgow score

Table 1. Comparison of baseline data (n/$\bar{x}$±S)

Group	Gender (male/female)	Age (years)	Time from onset to admission (h)	NIHSS score (points)	GCS score (points)
Control group (n=43)	24/19	52.14±3.49	3.52±1.15	14.25±3.25	11.85±2.14
Study group (n=43)	22/21	52.45±3.67	3.45±1.24	14.47±2.97	11.68±2.24
T	1.946	0.401	0.271	0.328	0.360
P	0.163	0.689	0.787	0.744	0.720

Table 2. Comparison of rescue outcomes [n (%)]

Group	Successful	Markedly effective	Effective	Ineffective	Total effective
Control group (n=43)	10 (23.26)	13 (30.23)	9 (20.93)	11 (25.58)	32 (74.42)
Study group (n=43)	15 (34.88)	15 (34.88)	10 (23.26)	3 (6.98)	40 (93.02)
χ^2	-	-	-	-	5.460
P	-	-	-	-	0.020

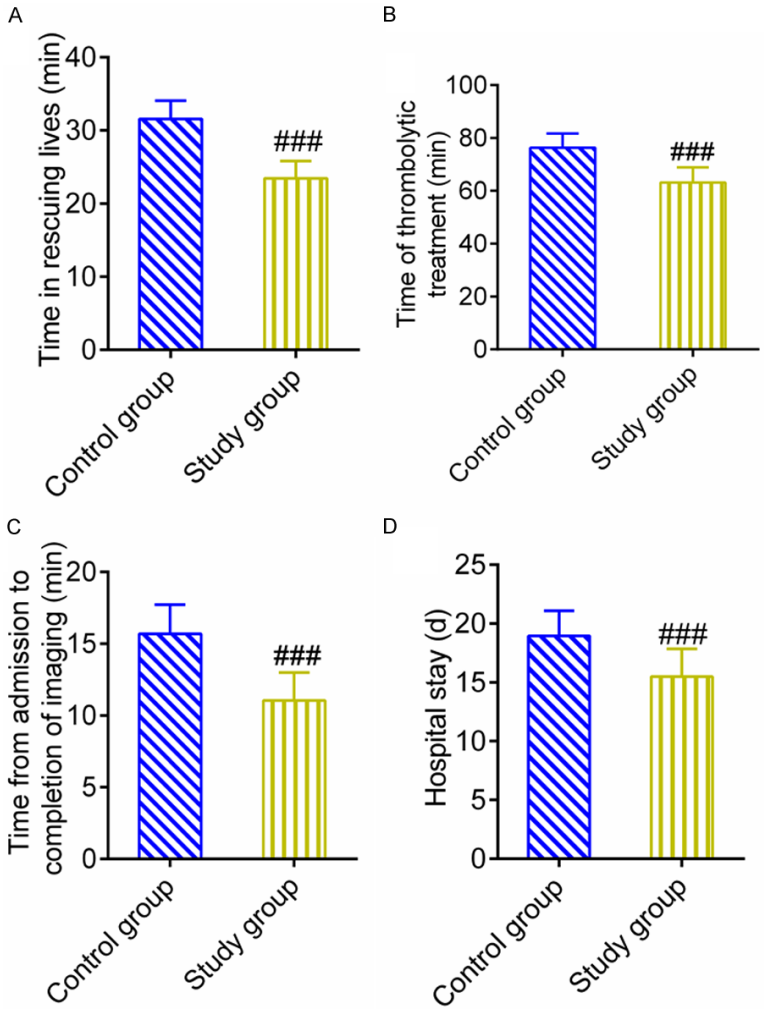

Figure 1. Comparison of rescue between the two groups. Note: A: Time to resuscitation; B: Time to thrombolytic therapy; C: Time from admission to completion of imaging; D: Length of hospital stay. Compared with the control group, ###*P*<0.001.

(GCS) between the two groups were not significant (*P*>0.05), indicating that the two groups were comparable (**Table 1**).

Resuscitation effect

The total effective rate of resuscitation was higher in the study group (93.02%) than in the control group (74.42%) (*P*<0.05), showing that the pre-hospital early intervention combined with in-hospital emergency model can effectively improve the success rate of rescue in patients with acute stroke (**Table 2**).

Resuscitation endpoints

Time to resuscitation, time to thrombolytic treatment, time from admission to completion of imaging, and the length of hospital stay were shorter in the study group than in the control group (*P*<0.05), indicating that the pre-hospital early intervention combined with in-hospital emergency mode can effectively improve the rescue effects (**Figure 1**).

Complication rate

The study group had a lower complication rate (4.65%) th-

Table 3. Comparison of complications between two groups [n (%)]

Group	Deep vein thrombosis	Pulmonary infection	Secondary epilepsy	Gastrointestinal bleeding	Total
Control group (n=43)	2 (4.65)	3 (6.98)	2 (4.65)	2 (4.65)	9 (20.93)
Study group (n=43)	1 (2.33)	1 (2.33)	0 (0.00)	0 (0.00)	2 (4.65)
χ^2	-	-	-	-	5.108
P	-	-	-	-	0.024

Table 4. Comparison of nursing satisfaction [n (%)]

Group	Very satisfied	Generally Satisfied	Dissatisfied	Satisfaction
Control group (n=43)	22 (51.16)	12 (27.91)	9 (20.93)	34 (79.07)
Study group (n=43)	29 (67.74)	13 (30.23)	1 (2.33)	42 (97.77)
χ^2	-	-	-	7.242
P	-	-	-	0.007

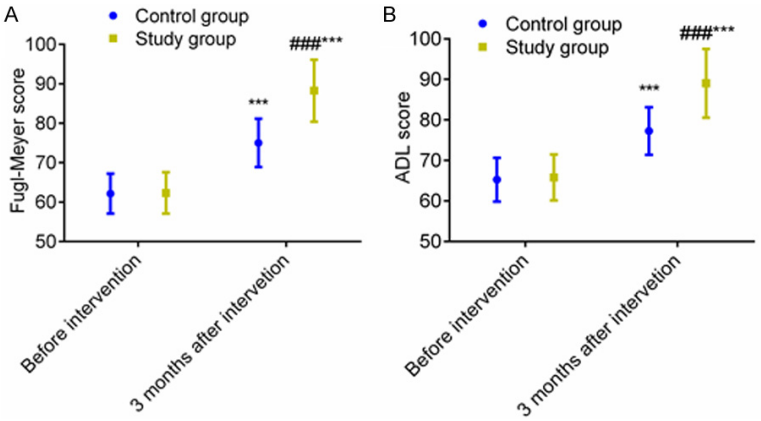

Figure 2. Comparison of limb motor function and daily living ability. Note: A: Fugl-Meyer score; B: ADL score. Compared with the control group, ###*P*<0.001; compared with those before treatment, ***P<0.001.

an the control group (20.93%) (*P*<0.05), suggesting that pre-hospital early intervention combined with in-hospital emergency mode can effectively reduce the incidence of complications in patients with acute stroke (**Table 3**).

Nursing satisfaction

Nursing satisfaction was higher in the study group (97.77%) than in the control group (79.07%) (*P*<0.05), exhibiting that pre-hospital early intervention combined with an in-hospital emergency model can effectively improve nursing satisfaction in patients with acute stroke (**Table 4**).

Limb motor function and ADL

Before intervention, the differences in Fugl-Meyer and ADL scores between the two groups were not significant (*P*> 0.05). Compared with the pre-intervention period, Fugl-Meyer and ADL scores were increased in both groups at 3 months after intervention, and were higher in the study group (*P*<0.05), showing that pre-hospital early intervention combined with an in-hospital emergency model can effectively improve limb motor function and ADL in patients with acute stroke (**Figure 2**).

Discussion

Acute stroke has a rapid onset, causing irreversible damage to brain tissue within a short period of time, and high disability and mortality [10, 11]. A study [12] has reported that early and effective treatment after the onset of acute stroke can effectively reduce the incidence of complications and reduce the morbidity and mortality rate. This shows the importance of carrying out pre-hospital interventions and giving targeted in-hospital rescue measures [13, 14].

In this study, pre-hospital early intervention combined with an in-hospital emergency model was adopted, and the results showed that the total rescue success rate and nursing satisfaction were higher in the study group than in the control group, and the complication rate was lower in the study group than in the control group, while the time to rescue, time to thrombolytic treatment, time from admission to completion of imaging, and the length of hospital stay in the study group were shorter than those in the control group, which were basically consistent with the findings of another study [15], suggesting that pre-hospital early intervention

combined with an in-hospital emergency model can effectively improve the outcomes of patients with acute stroke, shorten the length of hospital stay and prompt patient endorsement of care services. The reason for this may be that the routine emergency model has disadvantages such as poor pre-hospital and in-hospital articulation, unprofessional emergency personnel, and unconnected procedures, which can delay the rescue and affect the rescue effect [16]. Pre-hospital early intervention combined with an in-hospital emergency model can improve pre-hospital emergency services and in-hospital consultation and treatment, and make the whole emergency process compact and help the staff not panic through reasonable division of labor, which can enhance the rescue effect [17, 18]. In pre-hospital early intervention, stroke specialist nurses follow the ambulance to provide more professional services; the family is guided on first aid remotely by telephone to advance the time to first resuscitation and prevent deterioration of the patient's condition. After carrying out on-site first aid, the hospital Emergency Department was contacted to receive feedback on the patient's condition, so that the Emergency Department can receive the patients well in advance and shorten the time to rescue [19-21]. In the in-hospital emergency model, patients are evaluated and diagnosed in a timely manner, and emergency measures such as temperature control, hypotension, hypoglycemia, and thrombolytic therapy are carried out according to the specific conditions of the patients, thus enhancing the effect of rescue [22, 23].

It has been clinically found that some patients with acute stroke have limb movement dysfunction and more complications after treatment, which affects their ability to live their daily lives and is detrimental to their prognosis [24]. Therefore, it is crucial to improve limb movement function and reduce complications in patients with acute stroke to enhance ADL and improve prognosis. The results of this study showed that the incidence of complications was lower in the study group (4.65%) compared with the control group (20.93%). Compared with the pre-intervention period, the Fugl-Meyer and ADL scores were increased in both groups at 3 months after intervention and were higher in the study group. Yan et al. [25] have found that integrated in-hospital and out-of-hospital emergency care can effectively reduce the incidence of complications, which is consistent with the findings of this study, demonstrating that the pre-hospital early intervention combined with an in-hospital emergency care model can effectively reduce the incidence of complications, improve limb motor function, and promote the improvement of ADL.

In conclusion, pre-hospital early intervention combined with in-hospital emergency model for patients with acute stroke can effectively improve the success rate of rescue, shorten the time to resuscitation and length of hospitalization, reduce the incidence of complications, enhance nursing satisfaction, and improve limb motor function and ADL. However, the sample size of this study was small, and the effects on long-term prognosis were not observed, which will be explored in future studies.

Disclosure of conflict of interest

None.

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References

[1] Satti SR, Sivapatham T and Eden T. Radial artery neuro guide catheter entrapment during mechanical thrombectomy for acute ischemic stroke: rescue brachial plexus block. Interv Neuroradiol 2020; 26: 681-685.

[2] Lindsberg PJ, Kuisma M and Mattila OS. How development of blood biomarkers could benefit prehospital management of acute stroke. Biomark Med 2017; 11: 1043-1046.

[3] Patro SN and Iancu D. Dual-stent retrieval for mechanical thrombectomy of refractory clot in acute stroke as a rescue technique. CMAJ 2017; 189: E634-E637.

[4] Kim YW, Kang DH, Hwang YH, Kim YS and Park SP. Early anticipation of candidacy for intra-arterial reperfusion therapy based on baseline clinical stroke subtypes: comparison with multiparametric MRI taken within 4.5 hours from stroke onset. Cerebrovasc Dis Extra 2013; 3: 85-94.

[5] Danek BA, Karatasakis A, Karacsonyi J, Rangan BV, Abdullah S, Sorajja P, Banerjee S and

Brilakis ES. Diverse perspectives and training paths in cardiology: an analysis of authorship in the journal of the American College of Cardiology. Hellenic J Cardiol 2019; 60: 352-354.
[6] Goyal M, Simonsen CZ and Fisher M. Future trials on endovascular stroke treatment: the not-so-easy-to-pluck fruits. Neuroradiology 2018; 60: 123-126.
[7] Sanello A, Gausche-Hill M, Mulkerin W, Sporer KA, Brown JF, Koenig KL, Rudnick EM, Salvucci AA and Gilbert GH. Altered mental status: current evidence-based recommendations for prehospital care. West J Emerg Med 2018; 19: 527-541.
[8] Jin XM. Experience of in-hospital integrated emergency care model in acute ischemic stroke with intravenous thrombolysis. Electronic Journal of Practical Clinical Nursing 2020; 5: 142-143.
[9] Sun S. Guidelines for the diagnosis and treatment of acute ischemic stroke in China 2010. Chinese Journal of Neurology 2010; 43: 146-153.
[10] Nomura M, Tamase A, Kamide T, Mori K, Seki S, Iida Y, Kawabata Y, Nakano T, Shima H and Yanagimoto K. Superficial temporal artery-middle cerebral artery bypass using a Thick STA after endarterectomy: a rescue technique. J Neurol Surg A Cent Eur Neurosurg 2017; 78: 595-600.
[11] Okada H, Matsuda Y, Chung J, Crowley RW and Lopes DK. Utility of a Y-configured stentriever technique as a rescue method of thrombectomy for an intractable rooted thrombus located on the middle cerebral artery bifurcation: technical note. Neurosurg Focus 2017; 42: E17.
[12] Rallis D, Poulos P, Kazantzi M and Kalampalikis P. Rescue decompressive craniectomy in children with severe traumatic brain injury. J Pediatr Intensive Care 2018; 7: 33-38.
[13] An E and Howerton Child RJ. Complexities of identifying posterior cerebral artery cerebrovascular stroke. J Emerg Nurs 2020; 46: 210-213.
[14] Shi M, Zhou Y, Li Y, Zhu Y, Yang B, Zhong L, Pan R and Yang D. Young male with syphilitic cerebral arteritis presents with signs of acute progressive stroke: a case report. Medicine (Baltimore) 2019; 98: e18147.
[15] Topcuoglu MA, Tulek Z and Boyraz S. Acute stroke nursing: standards and practical applications Turkish Society of cerebrovascular disease and the society of neurological nursing: joint strategy project. Turk Serebrovaskuler Hastaliklar Dergisi 2020; 26: 1-90.
[16] Dwyer M, Peterson GM, Gall S, Francis K and Ford KM. Health care providers' perceptions of factors that influence the provision of acute stroke care in urban and rural settings: a qualitative study. SAGE Open Med 2020; 8: 2050312120921088.
[17] Galvin CL, Normandin PA, Horn KS and Popso JC. Intracranial infection mimics acute stroke in an adolescent male. J Emerg Nurs 2019; 45: 457-461.
[18] Baatiema L, Otim ME, Mnatzaganian G, de-Graft Aikins A, Coombes J and Somerset S. Health professionals' views on the barriers and enablers to evidence-based practice for acute stroke care: a systematic review. Implement Sci 2017; 12: 74.
[19] Simister R, Black GB, Melnychuk M, Ramsay AIG, Baim-Lance A, Cohen DL, Eng J, Xanthopoulou PD, Brown MM, Rudd AG, Morris S and Fulop NJ. Temporal variations in quality of acute stroke care and outcomes in London hyperacute stroke units: a mixed-methods study. Southampton (UK): NIHR Journals Library; 2020. pp. 1-98.
[20] Fowler SB, Rosado CA, Jones J, Ashworth S and Adams D. Novel use of a nurse-led telemedicine team in acute stroke: a retrospective review of the impact on a regional health care system. J Emerg Nurs 2019; 45: 242-248.
[21] Middleton S and Pfeilschifter W. International translation of fever, sugar, swallow protocols: the quality in acute stroke care Europe project. Int J Stroke 2020; 15: 591-594.
[22] Gaio M, Buoite Stella A, Furlanis G, Naccarato M, Stefi D and Manganotti P. Effect of a passive intervention on carers of stroke survivors during the early poststroke period. J Neurosci Nurs 2019; 51: 299-304.
[23] Barker A, Doeltgen S, Lynch E and Murray J. Perceived barriers and enablers for implementing water protocols in acute stroke care: a qualitative study using the theoretical domains framework. Int J Speech Lang Pathol 2019; 21: 286-294.
[24] Staszewski J, Dębiec A, Derbich M, Antoniak M and Stępień A. Frequency, risk factors, and clinical significance of incorrect dose of alteplase due to weight estimation in acute ischemic stroke patients: a single-center retrospective study. J Neurosci Nurs 2019; 51: 267-272.
[25] Yan J, Chen J and Liu L. Impact of pre-hospital-in-hospital integrated trauma emergency care model on the prognosis of patients with acute hemorrhagic stroke. Qilu Nursing Journal 2019; 25: 77-80.