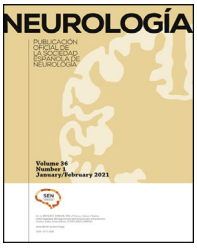
Neurología 38 (2023) 419—426

NEUROLOGÍA

www.elsevier.es/neurologia



REVIEW ARTICLE

Management of acute stroke. Specific nursing care and treatments in the stroke unit

E. Sanjuan[a,*], O. Pancorbo[a,b], K. Santana[a], O. Miñarro[a], V. Sala[a], M. Muchada[a], S. Boned[a], J.M. Juega[a], J. Pagola[a], Á. García-Tornel[a], M. Requena[a], N. Rodríguez-Villatoro[a], D. Rodríguez-Luna[a], M. Deck[a], M. Ribo[a], C.A. Molina[a], P. Meler[a], V. Romero[a], G. Dalmases[a], M.T. Rodríguez-Samaniego[a], L. Calleja[a], T. Gutierrez[a], L. Peña[a], J.C. Gallego[a], E. Lorenzo[a], Y. Gonzalez[a], R. Moreno[a], M. Rubiera[a]

[a] *Unidad de Ictus, Servicio de Neurología, Vall d'Hebron Hospital Universitari, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain*
[b] *Departament de Medicina, Universitat Autònoma de Barcelona, Barcelona, Spain*

Received 4 June 2020; accepted 29 July 2020

KEYWORDS
Clinical practice guidelines;
Stroke unit;
Stroke;
Nursing;
Protocols;
Reperfusion

Abstract
Objective: This study provides a series of updated, evidence-based recommendations for the management of acute stroke. We aim to lay a foundation for the development of individual centres' internal protocols, serving as a reference for nursing care.
Methods: We review the available evidence on acute stroke care. The most recent national and international guidelines were consulted. Levels of evidence and degrees of recommendation are based on the Oxford Centre for Evidence-Based Medicine classification.
Results: The study describes prehospital acute stroke care, the operation of the code stroke protocol, care provided by the stroke team upon the patient's arrival at hospital, reperfusion treatments and their limitations, admission to the stroke unit, nursing care in the stroke unit, and discharge from hospital.
Conclusions: These guidelines provide general, evidence-based recommendations to guide professionals who care for patients with acute stroke. However, limited data are available on some aspects, showing the need for continued research on acute stroke management.

DOI of refers to article: https://doi.org/10.1016/j.nrl.2020.07.025.
* Corresponding author.
E-mail address: estela.sanjuan@vhir.org (E. Sanjuan).

https://doi.org/10.1016/j.nrleng.2020.07.026

PALABRAS CLAVE
Guías de práctica clínica;
Unidad de ictus;
Ictus;
Enfermería;
Protocolos;
Reperfusión

Manejo del ictus agudo. Tratamientos y cuidados específicos de enfermería en la Unidad de Ictus

Resumen
Objetivo: Proporcionar un conjunto de recomendaciones actualizadas y basadas en la evidencia disponible para el manejo del ictus agudo. Nuestro objetivo es proporcionar una base para el desarrollo de los protocolos internos de cada centro, sirviendo de referencia para los cuidados de enfermería.
Métodos: Revisión de evidencias disponibles sobre los cuidados del ictus agudo. Se han consultado las guías nacionales e internacionales más recientes. Los niveles de evidencia y grados de recomendación se han basado en la clasificación del Centro de Medicina Basada en la Evidencia de Oxford.
Resultados: Se describen la atención y los cuidados del ictus agudo en la fase prehospitalaria, el funcionamiento de código ictus, la atención por el equipo de ictus a la llegada al hospital, los tratamientos de reperfusión y sus limitaciones, el ingreso en la unidad de ictus (UI), los cuidados de enfermería en la UI y el alta hospitalaria.
Conclusiones: Estas pautas proporcionan recomendaciones generales basadas en la evidencia actualmente disponible para guiar a los profesionales que atienden a pacientes con ictus agudo. En algunos casos, sin embargo, existen datos limitados demostrando la necesidad de continuar investigando sobre el manejo del ictus agudo.

Stroke is the leading cause of severe disability in adults, as well as the main cause of death among women and the second among men in Spain.[1] Although this condition represents a major health problem with sudden onset, it can be prevented, treated, and cured.

Management of acute stroke includes therapeutic interventions that, when applied early, significantly improve functional prognosis. In the case of ischaemic stroke, which accounts for 80% to 85% of strokes, such reperfusion treatments as intravenous thrombolysis (IVT)[2] and endovascular treatment with mechanical thrombectomy[3] have shown to be effective and safe (level of evidence 1, grade of recommendation A); both treatment approaches are time-dependent. Furthermore, stroke units and multidisciplinary care plans help to decrease morbidity and mortality rates in all types of stroke.[4]

Prehospital setting

The first step in patient management is fast, effective recognition of stroke symptoms by prehospital services. Code stroke must be activated if acute stroke is suspected. Code stroke is an urgent care protocol aiming to facilitate patient access to reperfusion therapy in the shortest time possible.[5] This underscores the need for a stroke care network enabling patient management at the most appropriate centre for the severity of their condition, with cooperation between hospitals from different levels of care and prehospital emergency services.

Several tools have been validated for use in the prehospital setting, which are helpful in detecting stroke and determining its severity. The Cincinnati Prehospital Stroke Scale is a fast, easy method for assessing the presence of 3 signs of stroke.[6] The Rapid Arterial Occlusion Evaluation (RACE) is highly sensitive for predicting large-vessel arterial occlusion for scores over 4 points, enabling the detection of patients eligible for endovascular treatment.[7]

New technologies improve communication between different actors in emergency stroke care, with the destination hospital being alerted in advance about patient referrals, the estimated time of arrival, and patient characteristics. Furthermore, telemedicine or telestroke programmes enable the administration of IVT at local hospitals under remote supervision by a vascular neurologist from a tertiary hospital (where high-complexity stroke treatments are administered) and subsequent referral of the patient for assessment of eligibility for mechanical thrombectomy or admission to the stroke unit.

There is controversy around the most suitable patient referral model. Two models have been proposed: the drip-and-ship model prioritises thrombolysis, recommending patient transfer to the closest primary care centre, whereas the mothership model consists in direct patient transfer to the tertiary care centre where the entire stroke care process will take place (from ultra-rapid diagnosis to reperfusion therapy). At present, insufficient evidence is available to determine which model provides greater clinical benefits. Several studies currently underway may help to optimise care pathways in code stroke.

Hospital setting

When a patient with suspected stroke is admitted to hospital, the standard procedure is immediate care at the

emergency department, preferably provided by a vascular neurologist.[8] Subsequently, and as soon as possible, a simple, non-contrast brain CT scan is performed. This fast, efficient diagnostic tool for the detection of brain haemorrhage enables early diagnosis of ischaemic stroke and helps to determine whether the patient is eligible for IVT. In addition to simple CT, many hospitals attending patients with acute stroke perform multimodal CT, which also includes angiography and perfusion studies. These tests, together with the patient's clinical signs, provide valuable information for treatment decision-making, especially in cases of uncertain onset and in patients eligible for thrombectomy.[9]

Immediate care in the CT room or the angiography room from the specialised stroke team significantly reduces treatment times.[10,11] This measure is being implemented in hospitals whose organisation enables the incorporation of a nurse to the stroke team (emergency department, stroke unit/neurology department, or radiology department) for in situ treatment administration. Thus, after code stroke activation, the stroke team awaits the ambulance at the emergency department and accompanies the patient during transfer to the CT room by prehospital emergency care professionals, gathering information about symptom onset, symptoms, and the patient's medical history. An initial assessment is performed, and nursing care is provided to normalise glucose levels and blood pressure. A peripheral venous catheter is inserted to obtain a blood sample for basic analysis (complete blood count, biochemistry study, and coagulation study). After the CT scan, IVT is started if it is not contraindicated (0.9 mg/kg, maximum dose of 90 mg; 10% of the dose is administered as an intravenous bolus and the remainder by 1-h IV infusion).

Endovascular reperfusion is considered if multimodal neuroimaging confirms intracranial artery occlusion. Reperfusion therapies are performed in large-calibre vessels, usually using a femoral access to reach the occluded artery and extract the thrombus (mechanical thrombectomy). Occasionally, thrombectomy may be combined with such other procedures as local administration of fibrinolytics (intra-arterial fibrinolysis) or balloon angioplasty, with or without stent placement.

In the context of code stroke in Catalonia, around 33% of patients with acute ischaemic stroke receive fibrinolysis, 20% undergo thrombectomy, and 8% receive a combination of both procedures.[12] The main limitations of IVT are the narrow therapeutic window, its poor effectiveness in cases of large-vessel occlusion (internal carotid artery, initial segment of the middle cerebral artery, basilar artery), and the fact that it is contraindicated for patients with increased risk of haemorrhagic complications (recent surgery, history of anticoagulation therapy). Symptomatic intracerebral haemorrhage (ICH), occurring in 2% to 11% of cases, is the most feared complication of this intervention. Other complications include systemic haemorrhage and allergic reactions (1.3%—5.1%).[2] Endovascular interventions, in contrast, are more complex and can only be performed at hospitals with experience in the procedure and the necessary material, human, and organisational resources (tertiary stroke centres). Although endovascular treatment achieves recanalisation in nearly 90% of cases, good radiological outcomes are not always associated with good clinical outcomes (futile recanalisation). Furthermore, endovascular treatment presents several risks: symptomatic ICH occurs in 3% of cases, and other complications including embolisation to new territories (5%—8%), artery dissection (1%—4%), and artery perforation (0.6%—5%).[3]

After these interventions, the patient must be admitted to a stroke unit to receive advanced, specialised care.

Admission to a stroke unit

Stroke units are geographically delimited structures with continuous, non-invasive monitoring and multidisciplinary, specialised staff coordinated by stroke specialists, usually neurologists. Stroke units constitute the most effective approach to stroke care and provide the greatest benefit to the community, with proven efficacy in reducing mortality (17% decrease), recurrence, and dependence (25% decrease) (class I, level of evidence A).[4] The benefits of stroke units are even greater than those associated with reperfusion therapy in itself, as a greater number of patients receive specialised care. Stroke units are also cost-effective, as they contribute to reducing mean hospital stays and rates of institutionalisation and readmission. All patients with acute stroke should ideally be admitted to a stroke unit, since improvements are observed regardless of stroke subtype or severity, with the only exception being patients with an extremely low level of consciousness (who should be admitted to an intensive care unit) and those presenting severe functional disability prior to stroke. The duration of hospitalisation depends on patient characteristics and stroke subtype.[13]

Nursing care at the stroke unit

Staff at stroke units should include nurses specialised in stroke care, ideally at a ratio of one nurse per 2 beds (semi-intensive care), according to the European Stroke Organisation,[14] although ratios of 1:4 or 1:6 are acceptable in our setting, depending on the severity of the cases.[15] Care focuses on patient management according to pre-established protocols, aiming to prevent complications, identify these complications as early as possible, and provide specific care and/or treatment.

In stroke units, blood pressure monitoring is an essential part of stroke unit care. Arterial hypertension is frequent in these patients; it is linked to stroke itself, but also to stress, pain, pre-existing hypertension, and physiological responses to hypoxia. Normalisation of blood pressure in this context reduces cerebral oedema and the risk of haemorrhagic transformation, although an excessive decrease in blood pressure may be counterproductive as it may reduce perfusion in the area of penumbra and increase the extension of ischaemia. In many cases, arterial hypertension resolves spontaneously. Arterial hypotension, in contrast, rarely appears in this context; when it does, the cause should be determined and corrected. Optimal blood pressure values are controversial; Table 1 presents the target values recommended by the available guidelines on acute stroke management.[9,15,16] Due to the potential risk of haemorrhagic transformation associated with arterial hypertension, the

Table 1 Target blood pressure levels by stroke subtype or treatment received.

Type of stroke	Target BP	Class of recommendation and level of evidence
Acute ischaemic stroke	Provide treatment if BP > 220/120 mm Hg. In these cases, a 15% decrease in BP within 24 hours of stroke is a reasonable target.[9]	Class IIb, level C
Ischaemic stroke treated with reperfusion therapy	Before reperfusion: BP < 185/110 mm Hg[9] After reperfusion: BP < 180/105 mm Hg[9]	Class I, level B
Haemorrhagic stroke	SBP $\leq$ 140 mm Hg[17,18]	Class I, level B

BP: blood pressure; SBP: systolic blood pressure.

vital signs of patients receiving reperfusion therapy must be monitored frequently, especially in the first hours after the intervention. An example monitoring schedule may be blood pressure measurement every 15 minutes for the first 2 hours, every 30 minutes for the following 6 hours, and then every hour until 24 hours post-intervention or until a CT scan is performed. In patients with acute ICH, systolic blood pressure values between 150 and 220 mm Hg, and no contraindications for acute antihypertensive treatment, an acute reduction in systolic blood pressure to 140 mm Hg reduces growth of the ICH and may constitute an effective strategy for improving functional outcomes.[17,18]

The recommended approach to achieve these reductions in blood pressure is intravenous administration of short-acting antihypertensives (eg, labetalol, urapidil) as a bolus or in continuous perfusion, depending on the patient's needs.

In the first days after a stroke, 20% to 50% of patients present body temperature above 37.5 °C, up to 50% present hyperglycaemia, and 37% to 78% have dysphagia; these factors increase rates of morbidity and mortality.[19]

Presence of fever within 24 hours of stroke is associated with a two-fold increase in the risk of early death.[20] Fever must be treated early with antipyretics (eg, paracetamol), and any possible sources of infection should be identified. Nursing staff must be vigilant for and work to prevent healthcare-associated infections, paying special attention to proper hygiene prior to catheter manipulation, withdrawal of unnecessary devices, dysphagia management, etc. Empiric antibiotic therapy is not recommended unless the patient presents signs of infection.[9]

Tight glycaemic control is a top priority: hypoglycaemia may mimic ischaemic stroke and must be corrected immediately, whereas hyperglycaemia is an independent risk factor for poor prognosis. Studies suggest that persistent hyperglycaemia within 24 hours of stroke is associated with poorer outcomes; therefore, high glucose levels should be treated (target value below 180 mg/dL) and closely monitored to prevent hypoglycaemia.[21]

Dysphagia is a frequent complication; early detection may be effective in identifying patients at higher risk of aspiration. It is essential to verify that patients can swallow safely and effectively, with a view to ensuring proper hydration and nutrition. Several dysphagia screening tests have been developed, although insufficient evidence is available to determine which is the most effective. The most widely used tests in our setting are the water swallow test and the volume-viscosity swallow test. The screening test of choice should be performed before any oral medication or nutrition is administered, and repeated if the patient presents clinical changes.[19,22,23]

The Quality in Acute Stroke Care study[19] showed that following a FeSS (fever, sugar, swallowing) nursing care protocol reduces mortality and dependence by 16%, and that these effects persisted in the long term. The FeSS protocol is explained in greater detail in Table 2.

Below, we present a series of recommendations on nursing care for acute stroke patients and the prevention of complications at the stroke unit. Table 3 shows the levels of evidence for these recommendations.[5,9,15,16,22–28]

In patients who have already undergone an endovascular procedure, the puncture site must be inspected periodically due to the risk of local complications, such as bleeding, haematoma, and infection, or even such severe complications as critical limb ischaemia, internal haematoma, dissection, pseudoaneurysm formation, and retroperitoneal haemorrhage.[29]

Hospital discharge

Hospital discharge may be considered after resolution of the acute phase of stroke, when inpatient treatment and follow-up are no longer required. These patients may be prescribed secondary prevention treatment, including rehabilitation, when needed, after a complete aetiological study. Counselling should be provided to promote patient independence and involvement of relatives and/or the primary caregiver. The treating physician should also provide information about stroke, recovery, and the available resources, including stroke support organisations.[14] Patient education programmes during hospitalisation have been shown to be effective in increasing understanding of the disease among patients and their families. Group sessions promote communication between healthcare professionals and patients/families and increase satisfaction with the care received.[30]

Maintaining coordination of stroke care at this stage of the process is essential. The discharge report should contain all the necessary information to understand the

Table 2 Summary of the elements included in FeSS protocols described in the Quality in Acute Stroke Care study.

FeSS protocol	Determination	Management/treatment	Class of recommendation and level of evidence
Temperature	Every 4—6 h within first 72 h of stroke[15]	≥ 37.5 °C: antipyretics within 1 h of detection[15]	Class I, level B
Blood glucose	Upon arrival at emergency department/stroke unit, and every 4—6 h within first 72 h of stroke (or first 48 h in non-diabetic patients with normal glucose levels)[15]	≥ 180 mg/dL: insulin (according to instructions) within 1 h of detection[9]	Class IIa, level C
Dysphagia	Dysphagia screening test within 24 h of stroke, before oral nutrition/treatment[9,15]	Consultation with speech therapist if dysphagia is severe[15]	Class I, level B

FeSS: fever, sugar, swallowing.
Source: Middleton et al.[19]

Table 3 General recommendations for nursing care at the stroke unit.

	Recommendations	Class of recommendation and level of evidence
Head positioning	The benefits of lying flat (fully supine) or with the head elevated to at least 30° are not clearly established. The fully supine position may increase cerebral perfusion, providing benefits for patients with hyperacute stroke without increasing the risk of respiratory infection.[9,24]	Class IIb, level C
	This position may be maintained for the first 24 h or until the patient is haemodynamically stable.[9,24]	
Cardiac function	An electrocardiography study should be performed at admission.[9]	Class I, level B
	Cardiac function should be monitored to detect atrial fibrillation and other potentially severe arrhythmias requiring emergency intervention. Cardiac monitoring should be performed at least during the first 24 h.[9]	Class I, level B
	Echocardiography may be considered in patients with suspected cardioembolic stroke.[9]	Class IIa, level C
	The effectiveness of Holter monitoring is not clearly established.[9]	Class IIb, level C
Respiratory function	Pulse oximetry should be performed every 4 h to monitor oxygen saturation levels, with oxygen therapy to be administered when needed. Oxygen therapy should not be routinely administered to stroke patients. Target oxygen saturation values are 94%—98% in patients without respiratory disease and 88%—92% in patients at risk of hypercapnic respiratory failure.[25]	Class I, level C
Bladder function	Permanent urinary catheters should not be placed routinely due to the associated risk of urinary tract infections. They are only indicated in the event of acute urinary retention or when strict diuresis control is needed (eg, heart failure), and should remain in place for the shortest time possible.[9]	Class III, level C
	All patients must be screened for urinary incontinence and retention (overflow or other type), bowel incontinence, and constipation.[15]	Class I, level C
Safety	We should aim to prevent lesions or falls, providing a safe environment with handrails and other support measures, where needed.[23]	Class IIb, level C
Early mobilisation	The initial assessment of the need for early rehabilitation must be performed as soon as possible after admission (~48 h).[15]	Class I, level C

Table 3 (*Continued*)

	Recommendations	Class of recommendation and level of evidence
	After the 24-h mark, a multidisciplinary team should evaluate whether the patient is sufficiently clinically and haemodynamically stable to be placed in a seated position, if tolerated. Caution should be exercised in patients with severe artery occlusion or stenosis.[22]	Class IIa, level C
	Ultra-early mobilisation (before 24 h after the stroke) for prolonged periods of time has been shown to have a detrimental effect.[9,26]	Class III, level B
Neurological examination	Neurological assessment scales detect neurological improvement or worsening and should be systematically applied at admission, before reperfusion therapy, and at the established follow-up assessments.[9]	Class I, level B
	Specific stroke scales include the National Institutes of Health Stroke Scale (NIHSS) and the Canadian Neurological Scale (CNS). The Glasgow Coma Scale (GCS) is used in patients presenting stupor or coma.[15,16]	Class IIb, level C
	The CNS should be administered every 4 h in the first 48 h after stroke, every 8 h until 72 h, and every 24 h until discharge from the stroke unit.[16]	
	If the patient's condition worsens (1-point decrease on CNS or 4-point increase on NIHSS), an emergency head CT scan should be considered.[15,16]	Class IIb, level C
Prevention of deep vein thrombosis	In immobilised patients, prophylaxis with low—molecular weight heparin should be started within 24—48 h of symptom onset, unless contraindicated. Prophylactic treatment should be delayed to 24 h in patients receiving reperfusion therapy.[9]	Class IIa, level A
	In patients with a contraindication for antithrombotics, intermittent pneumatic compression systems should be used.[27]	Class I, level B
Mood alterations	Post-stroke depression should be screened for with validated, adapted tools, and appropriate treatment should be provided.[9,15]	Class I, level B
Hygiene and skin care	Intensive oral hygiene protocols may reduce the risk of aspiration pneumonia.[9]	Class IIb, level B
	Skin friction should be minimised or completely avoided. Pressure-relief mattresses and pressure-relief cushions for wheelchairs and other seats should be used until the patient regains mobility.[5]	Class I, level C
	Patients should be mobilised regularly, and proper skin hygiene should be provided, with adequate mosturising, avoiding excess moisture.[15]	Class I, level C
Nutrition	A personalised nutrition plan should be designed to manage dysphagia and meet each patient's nutritional needs.[28]	Class I, level B
	In patients with severe dysphagia and requiring enteral nutrition, a nasogastric tube should be placed as early as possible after admission or within 72 h after stroke.[15]	Class I, level C
	Dietary supplements may be appropriate in patients with or at risk of malnutrition.[9]	Class IIa, level B
Water and electrolyte balance	Fluid balance monitoring is recommended to maintain hydroelectrolytic balance, especially during the first 24 h (fluid therapy) and in patients with heart disease or renal insufficiency.[22,27]	Class I, level C

extent, severity, functional limitations, and prognosis of the disease, and provide information on pharmacological treatment, specific nursing care (urinary catheter, management of pressure ulcers, need for mobilisations, nutritional needs), and the rehabilitation plan, where applicable. Patients should be encouraged to seek immediate contact with primary care for initial clinical assessment. The primary care physician will review and assess the treatments received (stroke-related and other treatments), re-evaluate secondary prevention objectives, ensure understanding of treatment interventions, follow up on any potential adverse drug reactions, and monitor treatment adherence. Furthermore, he or she may establish an individualised care and rehabilitation plan (provided at home or on an outpatient basis), depending on the patient's neurological sequelae and complications.[31] Neurorehabilitation represents the only opportunity for improvement in patients with residual disability after stroke.

The role of specialised nursing staff, which has recently sparked considerable interest internationally, is very promising for the development of new models of nursing care, both in the acute phase and during the follow-up of these patients.

Conclusions

These general recommendations are based on the available evidence on acute stroke care. In some cases, however, data are limited, underscoring the need for further research in this field.

Although nurses play a pivotal role in stroke care, evidence on the recommendations presented in this study remains insufficient. Future studies with a higher level of evidence, directed by nursing professionals in collaboration with a multidisciplinary team, should be conducted to determine the interventions achieving the best outcomes.

Funding

This study has received no specific funding from any public, commercial, or non-profit organisation.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. Instituto nacional de estadística. Defunciones según la causa de muerte 2016 [accessed 15 Jun 2018]. Available from: http://www.ine.es/.
2. Lees KR, Blumki E, Von Kummer R, Brott G, Toni D, Grotta JC, et al. ECASS, ATLANTIS, NINDS and EPITHET rt-PA Study Group investigators. Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS NINDS, and EPITHET trials. Lancet. 2010;375:1695—703.
3. Goyal M, Menon BK, van Zwam WH, Dippel DW, Mitchell PJ, Demchuk AM, et al. HERMES Collaborators. Endovascular thrombectomy after largevessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials. Lancet. 2016;387:1723—31.
4. Langhorne P, Ramachandra S, Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke: network meta-analysis. Cochrane Database Syst Rev. 2020:CD000197, http://dx.doi.org/10.1002/14651858.CD000197.
5. Pérez de la Ossa N. El acceso precoz a centros de referencia de ictus ofrece beneficio clínico: el Código Ictus. Rev Neurol. 2008;47:427—33.
6. Kothari RU, Pancioli A, Liu T, Brott T, Broderick J. Cincinnati Prehospital Stroke Scale: reproducibility and validity. Ann Emerg Med. 1999;33:373—8.
7. Pérez de la Ossa N, Carrera D, Gorchs M, Querol M, Millán M, Gomis M, et al. Design and validation of a prehospital stroke scale to predict large arterial occlusion: the rapid arterial occlusion evaluation scale. Stroke. 2014;45:87—91.
8. Álvarez-Sabín J, Molina CA, Montaner J, Arenillas J, Pujadas F, Huertas R, et al. Beneficios clínicos de la implantación de un sistema de atención especializada y urgente del ictus. Med Clin. 2004;122:528—31.
9. Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, et al. Guidelines for the Early Management of Patients With Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Earl y Management of Acute Ischemic Stroke. A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. Stroke. 2019;50:e344—418, http://dx.doi.org/10.1161/STR.0000000000000211.
10. Sanjuan E, Girón P, Calleja L, Rodríguez-Samaniego MT, Santana KE, Rubiera M. Implementación de un protocolo de transferencia directa y movilización del equipo de ictus para reducir los tiempos de reperfusión. Emergencias. 2019;31:385—90.
11. Kamal N, Holodinsky JK, Stephenson C, Kashayp D, Demchuk AM, Hill MD, et al. Improving door-to-needle times for acute ischemic stroke: effect of rapid patient registration, moving directly to computed tomography, and giving alteplase at the computed tomography scanner. Cir Cardiovasc Qual Outcomes. 2017;10:e003242.
12. Registre Codi Ictus Catalunya (CICAT). Agència de Qualitat i Avaluació Sanitàries de Catalunya (AQuAS) [accessed 30 Mar 2020]. Available from: http://aquas.gencat.cat/ca/ambits/projectes/registre-cicat/resultats/cicat/.
13. Fuentes B, Díez-Tejedor E. Stroke Units. Many questions, some answers. Int J Stroke. 2009;4:28—37.
14. Bernd Ringelstein E, Chamorro A, Kaste M, Langhorne P, Leys D, Lyrer P, et al. European stroke organisation recommendations to establish a stroke unit and stroke center. Stroke. 2013;44:828—40.
15. Alonso de Leciñana M, Egido JA, Casado I, Ribó M, Dávalos A, Masjuan J, et al. GEECV. Revisión: guía para el tratamiento delinfarto cerebral agudo. Neurología. 2014;29:102—22.
16. Boulanger JM, Lindsay MP, Gubitz G, Smith EE, Stotts G, Foley N, et al. Canadian stroke best practice recommendations for acute stroke management: prehospital, emergency department, and acute inpatient stroke care 6th edition update 2018. Int J Stroke. 2018;13:949—84, http://dx.doi.org/10.1177/1747493018786616.
17. Hemphill JC 3rd, Greenberg SM, Anderson CS, Becker K, Bendok BR, Cushman M, et al. Guidelines for the management of spontaneous intracerebral hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2015;46:2032—60.
18. Anderson CS, Heeley E, Huang Y, Wang J, Stapf C, Delcourt C, et al. Rapid blood-pressure lowering in patients with acute intracerebral hemorrhage. N Engl J Med. 2013;368:2355—65.
19. Middleton S, McElduff P, Ward J, Grimshaw JM, Dale S, D'Este C, et al. QASC Trialists Group. Implementation of evidence-based treatment protocols to manage fever, hyperglycaemia, and swallowing dysfunction in acute stroke (QASC): a cluster randomised controlled trial. Lancet. 2011;378:1699—706, http://dx.doi.org/10.1016/S0140-6736(11)61485-2.
20. Prasad K, Krishnan PR. Fever is associated with doubling of odds of short-term mortality in ischemic stroke: an updated meta-analysis. Acta Neurol Scand. 2010;122:404—8.
21. Capes SE, Hunt D, Malmberg K, Pathak P, Gerstein HC. Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients: a systematic overview. Stroke. 2001;32:2426—32.
22. Middleton S, Grimley R, Alexandrov AW. Triage, treatment, and transfer evidence-based clinical practice recommendations and models of nursing care for the first 72 hours of admission to hospital for acute stroke. Stroke. 2015;46:e18—25, http://dx.doi.org/10.1161/STROKEAHA.114.006139.
23. Oyanguren B, Eimil M, González M, Jaén V. Atención hospitalaria del paciente con ictus. Manual de enfermería. Madrid; 2015 [accessed 22 Apr 2020]. Available from: https://www.amn-web.com/documentos/manual-para-enfermeria-en-ictus.pdf.

24. Anderson CS, Arima H, Lavados P, Billot L, Hackett ML, Olavarría VV, et al. Cluster-randomized crossover trial of head positioning in acute stroke. N Engl J Med. 2017;376:2437—47.
25. O'Driscoll BR, Howard LS, Eads J, Mak V. British Thoracic Society Guideline for oxygen use in adults in healthcare and emergency settings. BMJ Open Resp Res. 2017;4:e000170.
26. Bernhardt J, Langhorne P, Lindley RI, Thrift AG, Ellery F, Collier J, et al. AVERT Trial Collaboration Group. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. Lancet. 2015;386:46—55.
27. Dennis M, Sandercock P, Reid J, Graham C, Forbes J, Murray G, CLOTS (Clots in Legs Or sTockings after Stroke) Trials Collaboration. Effectiveness of intermittent pneumatic compression in reduction of risk of deep vein thrombosis in patients who have had a stroke (CLOTS 3): a multicentre randomised controlled trial. Lancet. 2013;382:516—24, http://dx.doi.org/10.1016/S0140-6736(13)61050-8.
28. Geeganage C, Beavan J, Ellender S, Bath PM. Interventions for dysphagia and nutritional support in acute and subacute stroke. Cochrane Database Syst Rev. 2012;10:CD000323, http://dx.doi.org/10.1002/14651858.CD000323.pub2.
29. Balami JS, White PM, McMeekin PJ, Ford GA, Buchan AM. Complications of endovascular treatment for acute ischemic stroke: prevention and management. Int J Stroke. 2018;13:348—61, http://dx.doi.org/10.1177/1747493017743051.
30. Rodríguez-Fernández E, Domínguez-González A, García-Dilla P, García-Mesa S, Núñez-Pedrosa R, Sánchez-Jiménez C. Desarrollo del programa de educación sanitaria del ictus agudo en el Hospital del Mar de Barcelona. Rev Cient Soc Esp Enferm Neurol. 2011;33:21—4.
31. Díez-Tejedor E, Fuentes Gimeno B, Campollo J, García Leal R, Palomino Aguado B, Egocheaga Cabello MI, et al. Grupo de trabajo del plan de Atención a los pacientes con ictus en la Comunidad de Madrid 2019. Foro Ictus. Ed. Dirección General de Coordinación de la Asistencia Sanitaria. Servicio Madrileño de Salud [accessed 22 Apr 2020]. Available from: http://www.madrid.org/bvirtual/BVCM020311.pdf.