Special Article

Can Stroke Network Improve Accessibility of Stroke Fast Track in North-eastern of Thailand?

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National Health Security Office (NHSO) reported incidence rates of stroke were rising from 163.55 to 318.85 patients per 100,000 populations in 2009 to 2019. The standard treatment for acute ischemic stroke is thrombolytic drug within 4.5 hours of stroke onset. The majority of Thailand population outside Bangkok, have very low chance to receive thrombolytic treatment due to limitation of CT machine and medical personnel. In the Northeastern Thailand, there were 23 million people in 20 provinces. Only 60 neurologists practiced in 16 provinces, 55 neurologists work in government hospital (provincial hospital) and 5 neurologist work in private hospital. There is no any neurologist work in community hospital. To facilitate thrombolytic drug use for acute ischemic stroke should be managed by the internists and emergency physicians instead of neurologists. Therefore, stroke network was set up for improve accessibility of stroke fast track. Roles of the main server hospitals are 1) provide thrombolytic treatment for acute ischemic stroke patients, 2) set up comprehensive stroke unit, 3) set up a clinical guideline for stroke fast track and acute ischemic stroke care for their service areas, 4) be consultant for their client hospitals regarding acute stroke care, 5) monitor the client hospitals and improve the client hospitals' services, and 6) provide interhospital conferences regarding acute stroke care among main service hospitals and client hospitals yearly.

Keywords: Stroke network, Accessibility, Thrombolytic drug

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Stroke is a main public health problem worldwide including Thailand. Thailand is located in Southeast Asia, has 65 million people, and has area equal to Spain. There are 250,000 new patients of stroke yearly. Stroke has the highest mortality rate in Thailand in both genders and also the highest disability-adjusted life year (DALYs) in female and the third ranking in male. Data from Ministry of Public Health of Thailand showed that the mortality rates from stroke are increasing gradually. The rates were 20.8, 21, 27.5, and 30 patients per 100,000 populations in the year 2008 to 2012, respectively. The prevalence rate of stroke is high at 1,880 patients per 100,000 populations in age group of 45 to 80 years[1-3]. National data based of National Health Security Office (NHSO) reported incidence rates of stroke were rising from 163.55 to 318.85 patients per 100,000 populations (more than 15 year-old) in the year 2009 to 2019, respectively.

The standard treatment for acute ischemic stroke is recombinant tissue plasminogen activator (rt-PA) within 4.5 hours of stroke onset or the 270 minutes of lives. In 2002, the first report of rt-PA treatment in Thailand has been published[4]. Later on, the rt-PA has been used more but only in university hospital and large private hospital; mostly in Bangkok. Healthcare facilities in Bangkok tend to be ready for rt-PA treatment in terms of availability of computed tomography (CT) machine and neurologists. Seventy-five percentages of neurologists work in Bangkok and around Bangkok areas and serve 10 million people. In 2008, the rate of the rt-PA treatment in Thailand was quite low at 0.01% and was used only in Bangkok[5]. The other 55 million people outside Bangkok, the majority of Thailand population, have very low chance to receive rt-PA treatment due to limitation of CT machine and medical personnel (neurologists/neurosurgeons).

In the northeastern Thailand, there were 23 million people in 20 provinces. Only 60 neurologists practiced in 16 provinces in this part of the country. Fifty-five neurologist work in government hospital (provincial hospital) and 5 neurologist work in private hospital. There is no any neurologist work in community hospital. To facilitate rt-PA use for acute stroke patients in Thailand, acute stroke care should be managed by the internists and emergency physicians instead of neurologists. In addition, several factors may be associated with stroke outcomes such as patient awareness, recognition, stroke care team, or availability of CT machine. Stroke network therefore is established to improve acute stroke care.

The stroke network is acute stroke care team that provides standard and effective care for all patients and all areas of Thailand. In addition to healthcare team, supportive team is also important such as private organizations, local

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government, or public relation team. There are three main components of the stroke network; stroke service system, stroke care team, and patients. To set up stroke fast track system in the hospitals is the important beginning and need advice from experienced neurologists. Using slogan may be a helpful tool for developing stroke fast track system such as "Stroke fast track is not difficult", "Everything is possible if we want to do".

Stroke care team is the most important component and comprised of all levels of healthcare personnel including director of the hospital, physicians, nurses, emergency room team, triage nurse, stroke ward/stroke corner, laboratory staff, and CT technicians. Once stroke fast track system is activated, the care team needs to be ready and provide fast and appropriate care. Physicians as a leader of the team should provide knowledge to all members and all levels. In addition, frequent and regular evaluation of the care team is also needed to improve the quality of care or solve any obstacles.

Patients are another important factor. If the stroke patients do not reach the hospital within the golden period of rt-PA treatment (270 minutes), the network and system would not be benefit. Therefore, public education is also one component of the stroke network. The education is comprised of risk factors of stroke, treatment, stroke fast track service, prevention of stroke, rehabilitation, and importantly stroke fast track recognition.

The stroke network project is comprised of main server and client hospitals. The main server hospitals are tertiary care hospital in each medical service area and be able to provide rt-PA treatment for all client hospitals in their service areas. The main server hospitals also have a stroke network committee which has three missions including develop the rt-PA service in potential community hospitals; shorten door to refer time and onset to needle time; educate public regarding stroke fast track and stroke network; assess and develop better stroke fast track service. Roles of the main server hospitals are 1) provide rt-PA treatment for acute ischemic stroke patients, 2) set up comprehensive stroke unit, 3) set up a clinical guideline for stroke fast track and acute ischemic stroke care for their service areas, 4) be consultant for their client hospitals regarding acute stroke care, 5) monitor the client hospitals and improve the client hospitals' services, and 6) provide interhospital conferences regarding acute stroke care among main service hospitals and client hospitals yearly.

The client hospitals have three roles including 1) develop rt-PA treatment in acute ischemic stroke by internists/emergency physicians and under supervision of the main server hospitals, 2) develop effective referral system with the main server hospitals, and 3) educate public and primary health care personnel in terms of stroke diagnosis, stroke fast track, and rt-PA treatment.

The National Health Security Office of Thailand (NHSO), a government organization deals with health care for 75% of Thai population, has supported a project of rt-PA use in university hospitals and tertiary care hospitals outside Bangkok. The project started in 2008 and the rt-PA use rate increased to 1% from 0.01% or 100% increasing in 2009. The rt-PA project has been implemented since then and continuously for hospitals all over Thailand. Rate of thrombolytic treatment in acute ischemic stroke patients increased to 4.82, 5.77, 6.59, 7.75 and 7.95 percentages in 2016 to 2020, respectively. Rate of thrombolytic treatment in each healthy zone were showed in Table 1.

The main issue of rt-PA project is limited numbers of neurologists/neurosurgeon. Internists/emergency physicians who trained for internal medicine/emergency physicians before 2008 have no clinical experience in rt-PA use during their trainings particularly in university hospitals outside Bangkok. Currently, there are 713 neurologists in Thailand. Of those, 450 neurologists practice in Bangkok or around Bangkok areas, 50 neurologists practice in Northern part of Thailand, 60 neurologists practice in North-eastern part of Thailand, 104 neurologists practice in Middle and Eastern part of Thailand, and 49 neurologist practice in Southern part of Thailand. Another issue is that Thai people has limited knowledge regarding acute stroke and stroke fast track or rt-PA treatment resulting in delayed diagnosis, treatment and not enrolled for rt-PA treatment.

The urgent need to set up the rt-PA treatment as a standard treatment for acute ischemic stroke is to educated physicians, health care personnel, and also Thai people regarding the rt-PA treatment. The NHSO incorporated with the Society of Neurology of Thailand, the Society of Stroke of Thailand, The National Institute of Neurology of Thailand, Department of Medical Services of Thailand, Ministry of Public Health, Medical schools to promote knowledge, attitude, and practice regarding acute stroke treatment.

There are 13 medical service areas in Thailand categorized by the NHSO and Ministry of Public Health of

Table 1. Rate of thrombolytic therapy of acute ischemic stroke patients

	2016	2017	2018	2019	2020
Zone 1	6.41	7.65	7.95	8.66	8.42
Zone 2	6.88	7.31	9.06	10.22	10.02
Zone 3	3.19	4.78	7.61	9.05	9.20
Zone 4	5.46	5.00	5.36	7.01	6.38
Zone 5	3.56	4.87	6.21	7.01	7.21
Zone 6	3.30	4.29	5.04	7.34	6.56
Zone 7	5.98	7.94	8.17	8.08	10.42
Zone 8	5.41	5.55	6.75	7.13	6.28
Zone 9	3.73	4.21	4.64	6.02	6.19
Zone 10	4.64	7.69	7.67	9.22	9.45
Zone 11	4.27	4.31	7.19	10.12	10.82
Zone 12	5.25	6.44	5.89	6.55	7.34
Zone 13	5.28	6.33	6.80	6.91	7.66
Thailand	4.82	5.77	6.59	7.75	7.95

Thailand. Each service area serves approximately 5 million people and has one tertiary care hospital. The tertiary care hospital basically has specialists in all areas including neurologists/neurosurgeons. In 2009, the stroke network policy has established to support the rt-PA use in acute ischemic stroke patients. This policy allows rt-PA treatment in university hospitals, tertiary care hospitals, or hospitals with availability of CT scan and internists/emergency physicians. These hospitals are served as referral centers or main servers for acute ischemic stroke treatment all over Thailand[6].

Outcomes of northeastern stroke network of Thailand

After the implementation of stroke network by the NHSO in 2009, the rate of rt-PA use in acute ischemic stroke patients was continuously increasing from 0.01% to 1% (in 2009), 1.7% (in 2010), 2.1% (in 2011), 2.3% (in 2012), 2.7% (in 2013), 3.2 (in 2014) and 3.9 (in 2015). Since 2016, rate of thrombolytic treatment in Northeastern acute ischemic stroke patients were continuously rising from 3.73% to 10.42% as showed in Table 1. It may be as high as 20% in some medical service area. In addition, rt-PA is now available in all provincial hospital in northeastern Thailand and in some community hospitals which run by internists/emergency medicine. Outcome of acute stroke patients were showed in Table 2 to 4. Outcomes of acute ischemic stroke patients are comparable between stroke networks run by neurologists and internists under supervision of neurologists[7,8].

Stroke network development in Thailand

The 7A principle is used to facilitate stroke fast track and stroke network. The 7A is comprised of

1) Awareness: Awareness of stroke in public

2) Alertness: Alertness of symptoms of stroke in public

3) Activate: Activate stroke fast track to the nearest hospital

4) Available: Available stroke fast track in all areas

5. Already: Readiness of the hospital for stroke fast track service

6) Audit: Audit of the stroke fast track

7) Away: Keep the people Away from stroke

Build up the stroke network

Treatment of stroke is not only stroke fast track

Table 2. In-hospital mortality rate of acute stroke patients

	2016	2017	2018	2019	2020
Zone 1	8.77	8.39	8.36	8.56	8.91
Zone 2	13.99	13.50	13.55	11.62	11.94
Zone 3	15.55	13.67	15.64	14.36	13.74
Zone 4	17.93	16.00	16.20	15.02	15.37
Zone 5	13.62	13.77	13.16	12.41	12.78
Zone 6	15.86	15.51	14.18	14.05	14.20
Zone 7	5.08	5.35	5.10	5.01	4.96
Zone 8	5.18	4.85	4.19	4.60	4.56
Zone 9	11.03	9.97	8.95	8.75	9.62
Zone 10	6.46	6.49	6.75	7.00	7.30
Zone 11	13.11	11.36	10.93	10.61	10.20
Zone 12	9.15	8.60	7.16	7.39	7.33
Zone 13	13.27	12.57	12.58	11.99	11.93
Thailand	11.75	11.02	10.60	10.24	10.33

Table 3. In-hospital mortality rate of acute ischemic stroke patients

	2016	2017	2018	2019	2020
Zone 1	4.24	4.24	4.11	4.23	3.99
Zone 2	6.97	6.37	6.88	4.70	4.86
Zone 3	7.89	6.09	6.91	6.97	6.70
Zone 4	8.91	7.43	7.71	7.18	7.23
Zone 5	6.07	7.00	6.55	5.30	5.83
Zone 6	7.39	6.99	6.11	6.58	6.39
Zone 7	2.27	2.06	1.98	1.85	1.67
Zone 8	2.74	1.99	1.74	2.23	2.16
Zone 9	5.14	4.05	3.67	3.46	4.44
Zone 10	3.39	2.78	2.87	2.69	3.18
Zone 11	7.21	5.55	5.32	5.31	5.58
Zone 12	5.08	4.08	3.34	3.68	3.50
Zone 13	7.53	6.99	6.33	6.62	6.63
Thailand	5.78	5.06	4.80	4.64	4.76

Table 4. Mortality rate of acute ischemic stroke patients with thrombolytic treatment

	2016	2017	2018	2019	2020
Zone 1	3.74	4.96	5.51	5.39	7.00
Zone 2	7.66	6.53	7.74	5.62	6.32
Zone 3	7.83	8.74	9.86	9.35	7.54
Zone 4	6.83	6.39	7.29	9.03	7.24
Zone 5	8.59	7.12	10.94	6.74	9.18
Zone 6	7.27	11.76	6.61	7.65	9.84
Zone 7	2.11	2.46	3.65	2.59	2.83
Zone 8	4.69	2.57	1.47	3.16	3.90
Zone 9	6.55	6.99	7.25	5.91	6.57
Zone 10	1.59	2.84	3.69	3.12	4.55
Zone 11	8.47	8.96	6.18	6.37	9.12
Zone 12	6.25	9.30	5.88	6.62	6.14
Zone 13	5.48	6.49	8.54	6.08	8.03
Thailand	5.73	6.24	6.38	5.94	6.75

Table 5. Healthcare activities in the stroke network by hospital levels

Activities	Tertiary care	Secondary care	Primary care
Stroke fast track	+++	++	+
Stroke ward	+++	+++	+
Prevention	+++	+++	+++
Rehabilitation	+++	+++	+++
Service network	+	++	+++
Referral system	+	++	+++
Public education	+	++	+++

"plus" signs indicated level of importance from least (+) to the most (+++).

but also rehabilitation and prevention of stroke. The stroke network therefore includes these holistic approaches of stroke treatment. Activities of the stroke network may vary by hospital levels as shown in Table 5.

Public education

Public should be knowledgeable regarding stroke and stroke treatment. This is one of important strategies to improve stroke outcomes. Public education used in Thailand is comprised of stroke basic knowledge and stroke treatment. Stroke knowledge for public includes symptoms of stroke, importance of early treatment by rt-PA, benefits and side effects of rt-PA, life style modifications for stroke prevention, and roles of community for caring of stroke patients. The knowledge is disseminated to public organizations, students, and also mass media personnel. The media for stroke knowledge are inforgraphic, facebook, pamphlets, songs, cartoons, radio, websites, newspapers, spot radio, short movies, and books. In addition, World Stroke day campaign is also used for public awareness. The concept for stroke fast track is also distributed under the slogan of "Having acute stroke, please call 1669". The 1669 number is an emergency medical service (EMS) service that will lead acute stroke patients to the appropriate healthcare facilities. To activate stroke fast track is comprised of 8D steps including detection, dispatch, delivery, door, data, decision, drug and disposition. These steps were made as a short movie and posted in the social media such as Youtube and Facebook.

Referral system

The referral system for stroke network is a two-way referral system; from healthcare facilities without stroke fast track to the stroke fast track healthcare facilities for rt-PA treatment and backward referral when the stroke patients are stable and post rt-PA treatment. We try to set up stroke network by establish stroke center which can do thrombolytic treatment every 60 to 80 kilometers. Because acute stroke patients need to treat with thrombolytic as soon as possible, and good outcome depend on onset to needle time, especially within 60 to 120 minutes. There are 28 community hospitals in 20 provinces of Northeast Thailand.

Rehabilitation and home program

Post stroke treatment such as rehabilitation and home program are another important part of stroke network. Home visit can reduce healthcare burden and also provide mental care of stroke patients and family members. Khon Kaen provincial stroke network developed Stroke@BI for home visit care system. Stroke@BI is web-based program for register every stroke patient who was discharged from stroke center. The information of stroke patient was sent to primary care unit (PCU) which patient's address.

Conclusion

To develop stroke network to provide effective stroke care in Thailand is challenging. Several strategies are needed including sufficient stroke fast track healthcare facilities, acute stroke care team, referral system, home rehabilitation team, and patient education. The rt-PA use is 7.95% of acute ischemic stroke patients nationwide. And rate of thrombolytic treatment is more than 10.00% in healthy zone 2, 7 and 11. Every team member of stroke network is important and needs to work with kindness and mind to provide best stroke care. Stroke network in Thailand increases rate of rt-PA use in acute ischemic stroke patients. Outcomes of stroke network by neurologists, internists and emergency physicians are similar.

What is already known in this topic?

The standard treatment for acute ischemic stroke is thrombolytic drug within 4.5 hours of stroke onset.

What this study adds?

To develop stroke network to provide effective stroke care in Thailand is challenging. Several strategies are needed including sufficient stroke fast track healthcare facilities, acute stroke care team, referral system, home rehabilitation team, and patient education.

Conflicts of interest

The authors declare no conflicts of interest.

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