Siriraj Acute Stroke Unit: 10 Years Experience

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Background: *Stroke is the second most common cause of death and leading cause of adult disability worldwide. The recent publication guidelines suggest that there are treatment strategies for optimizing the management of acute stroke patients including thrombolytic therapy, antiplatelet drugs and the establishment of a stroke unit. In Thailand, the first stroke unit has been established since May 1997 and was named Siriraj Acute Stroke Unit (SASU).*

Material and Method: *The authors retrospectively analyzed the data of stroke patients who were admitted in the SASU from May 1997 to May 2007, as well as hyper acute stroke (within 3 hours after onset). The statistical analysis was performed by using SPSS 11.0.*

Results: *There were 2,109 patients admitted to the SASU during 10 year-period. The mean age of all patients was 65.35 years (range14-94 years, median 69.2 years). Stroke subtypes were classified as infarction (including transient ischemic attack) in 1799 patients (86.7%) and hemorrhage in 310 patients (13.26%). The most common stroke mechanism was small vessel disease (38.97%). The mainly ischemic stroke distribution was middle cerebral artery territory (77.14%). Risk factors of stroke were as follow: hypertension (61.79%), diabetes mellitus (35.47%), hyperlipidaemia (46.58%), smoking (21.02%) and prior stroke or coronary heart disease (23.74%). Mortality rate was 3.4% mainly due septicemia (26 patients). The mean total hospital stay of stroke patients at the SASU was 13.81 days (ranging from 1-120 days). There were thirty hyper-acute ischemic stroke patients who received intravenous thrombolytic therapy (between August 2005 and May 2007) for which the mean age was 70.7 years (ranges 48-88 years, median 74.5 years). Mean initial National Institutes of Health Stroke Scale (NIHSS) was 14.27. Intracranial hemorrhage after intravenous thrombolytic therapy was found in 8 patients which include 3 patients with symptomatic hemorrhage.*

Conclusion: *The standard of care in SASU is not inferior to other stroke unit worldwide. Admission of acute stroke patient to the SASU provides a better chance of survival as well as a shorter length of hospital stay.*

Keywords: *Stroke unit, Acute stroke, Treatment, Mortality, Length of stay*

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Stroke is the second most common cause of death and leading cause of disability in adults worldwide[1]. It is the most common life-threatening neurological disorder, and often results in severe disability[2]. The burden of stroke on patients, their families, and society is correctly publicized in most developed countries. Stroke in the developing world is less well documented and some data are not retrievable because of the language barrier or the limited data collection. Nevertheless, over two-thirds of stroke deaths worldwide are in developing countries[3].

Moreover, Asia-Pacific Consensus Forum on Stroke Management has predicted that the burden of stroke will grow most rapidly in developing countries rather than in developed countries in the next 30 years[4]. Because of a rapid economic and health care development, over time, the proportion of elderly people in the population will likely increase, life expectancies will be lengthen and the influence of a Westernized lifestyle might shift disease patterns towards a profile more similar to that seen in more developed regions.

The collected mortality data in Thailand revealed that stroke was the highest cause of death in

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females, and the third highest in males[5]. It is estimated that there are around 150,000 new cases of stroke per year. Stroke subtypes were reported to be 30 percent cerebral hemorrhage and 70 percent cerebral infarction[4]. These data are similar to the data gathered in other Asian countries.

The recent publication guidelines suggest that there are treatment strategies for optimizing the management of acute stroke patients including thrombolytic therapy, antiplatelet drugs and the establishment of the stroke unit[6,7]. An updated systematic review has confirmed significant reductions in death (3 percent absolute reduction), dependency (5 percent increase in independent survivors), the need for institutional care (2 percent reduction) and reduction in the length of hospital stay for patients treated in a stroke unit, when compared with those treated in general wards. All types of patients, irrespective of gender, age, stroke subtype and stroke severity, appear to benefit from treatment in stroke units[8,9]. These results have also been confirmed in large observational studies of routine practice[10-12]. In addition, the stroke unit is also proven to be cost-effective[13-16].

In Thailand, the first stroke unit was established in May 1997 and was named Siriraj Acute Stroke Unit (SASU). The authors analysed the data of SASU, between May 1997 and May 2007 in many aspects in order to provide information about the 10 years experience of stroke management in the first stroke unit in Thailand.

Material and Method

Data of stroke patients, who were admitted in SASU during May 1997 to May 2007 were analysed using SPSS 11.0. During the first 8 years, the main criteria for stroke unit admissions were (1) acute stroke patients whose onset was less than 7 days and aged over 13 year-old, (2) did not required mechanical ventilator and (3) Glasgow Coma Scale (GCS) was over 11/15 on admission. But in the last 2 years (2005 to 2007), the criteria for admission were changed to include more comprehensive care. SASU then could support mechanical ventilator and GCS lower than 11/15. More importantly, we established "Stroke fast track" for the hyperacute stroke patients (within 3 hours after stroke onset) and one bed is always available for this category of patients.

All patients were treated by a well-organized multidisciplinary team of staff including neurologists, nurses, physiotherapists and nutritionists. A standard treatment was performed with regard to the diagnostic evaluation, neurological assessment, monitoring and early rehabilitation. Patients were also prepared for long-term care including risk factor management and secondary prevention. Investigations included blood tests (complete blood count, blood sugar, blood urea nitrogen, creatinine, electrolyte, lipid profile and liver function test), chest radiography, electrocardiography, and brain imaging (computer tomography (CT) or magnetic resonance imaging (MRI) of the brain). Early initiation of treatment was done with intravenous fluid replacement, antipyretics, blood sugar control and particularly, antiplatelets. In the acute stroke patient, who was not eligible for intravenous thrombolysis, aspirin was initiated as soon as possible after the brain scan showed no evidence of hemorrhage. All patients were also worked up for the causes of stroke. If cardioembolic stroke was suspected, a cardiologist was consulted. The patients were mobilized as early as possible. In case of clinically worsening conditions such as impending brain herniation or severe sepsis or patients who needed neurosurgical intervention, they would be transferred from SASU to the medical intensive care unit (ICU).

The authors retrospectively analyzed the data including age, sex, types of stroke, associated diseases, stroke risk factors as well as stroke locations. The rate of complications and mortality during the admission were calculated. The mean length of stay was also recorded. The complications (including neurological or systemic complications) were analysed. All the expired cases, including the patients who were transferred to the ICU and neurosurgical ward, were verified for the causes of death. Statistical analyses with simple descriptive analysis such as percentage, means and range were used as appropriate.

Results

There were 2,109 patients admitted to the SASU during 10 year-period; 1,119 were male (52.14 percent) and 990 were female (47.86 percent). The mean age was 65.35 years, ranging from 14 to 94 years (median 69.2 years). There was no difference in the distribution of the age between male and female groups.

Stroke subtypes were classified as infarction (including transient ischemic attack) in 1,799 patients (86.74 percent) and hemorrhage in 310 patients (13.26 percent), which was intracerebral hemorrhage in 92.98 percent and subarachnoid hemorrhage in 7.02 percent.

Mechanisms (according to TOAST classification[17]) and distribution of cerebral infarction are shown in Fig. 1 and 2. Location of hemorrhagic

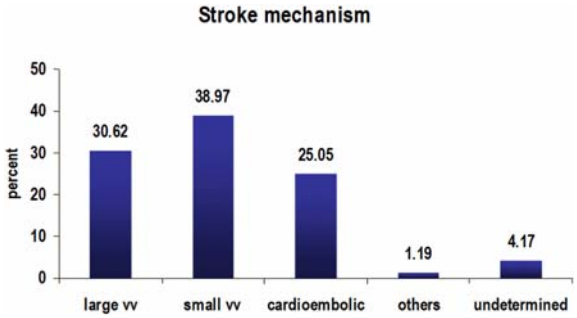
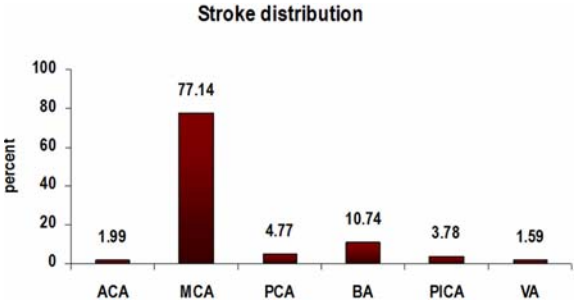


Fig. 1 The bar graph demonstrates different mechanisms of cerebral infarction (according to TOAST classification) of ischemic stroke patients, who were admitted in Siriraj Acute Stroke Unit between May 1997 to May 2007 (n = 1,799)



ACA = Anterior cerebral artery, MCA = Middle cerebral artery, PCA = Posterior cerebral artery, BA = Basilar artery, PICA = Posterior inferior cerebellar artery, VA = Vertebral artery

Fig. 2 The bar graph demonstrates distributions of ischemic stroke patients, who were admitted in Siriraj Acute Stroke Unit between May 1997 to May 2007 (n = 1,799)

stroke was shown in Fig 3.

Risk factors of ischemic stroke were as following: hypertension (61.79 percent), diabetes mellitus (35.47 percent), hyperlipidemia (46.58 percent), smoking (21.02 percent) and prior stroke or coronary heart disease (23.74 percent). From May 2005-May 2007, the newer database also included the results of more advanced neuroimaging (MRI, MRA of the brain and carotid ultrasound) and echocardiogram, which were performed in ischemic stroke patients. Investigations of all ischemic stroke patients admitted during May 2005 and May 2007 are shown in Table 1.

The mortality rate of patient was 3.4 percent (47 of 2,109 patients); 13 patients died from massive brain edema and herniation (27.66 percent), 26 patients died from sepsis (55.32 percent), 7 patients died from

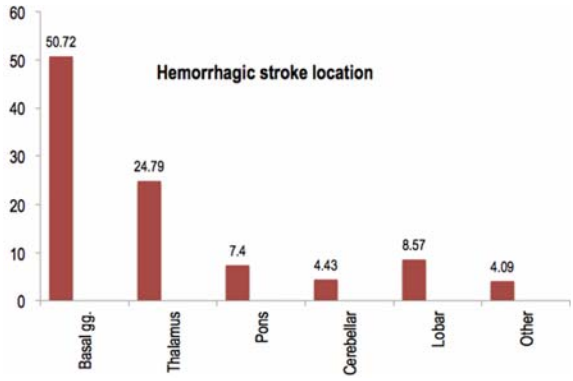


Fig. 3 The bar graph demonstrates different locations of hemorrhagic stroke patients, who were admitted in Siriraj Acute Stroke Unit between May 1997 to May 2007 (n = 310)

acute myocardial infarction (14.89 percent) and 1 patients died from pontine hemorrhage (2.13 percent). Complications of all patients are shown in Fig. 4.

There were 5 cases of decubitus ulcer (superficial grading) found among 2,109 stroke patients admitted in the SASU (0.39 percent). The mean length of hospital stay was 13.81 (SD 13.52) days, ranging from 1-120 days.

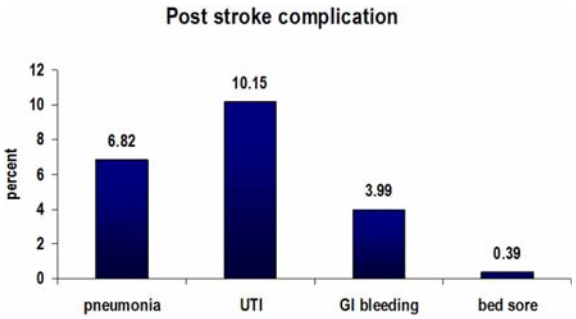
The first case of intravenous thrombolytic therapy in Siriraj hospital was first recorded on 23th August 2005. There were thirty hyper-acute ischemic stroke patients, who received intravenous thrombolytic therapy (between August 2005 and May 2007), 13 were male and 17 were female. The mean age of patients, who received thrombolysis was 70.7 years (ranges from 48 to 88 years, median 74.5 years). Mean initial National Institutes of Health Stroke Scale (NIHSS) was 14.27. Regarding the severity of stroke, 16 patients had moderate NIHSS score (8-16) and 20 patients had severe NIHSS score (more than 17). Intracranial hemorrhage after intravenous thrombolytic therapy were found in 8 patients (26.67 percent), which included 3 patients with symptomatic hemorrhage (10 percent).

Discussion

A stroke unit consists of a discrete area of a hospital ward that exclusively or nearly exclusively takes care of stroke patients and is staffed by a specialist multidisciplinary team[10]. The core disciplines of the team are physician, nurse, physiotherapist, occupational therapist, speech and language therapist and social worker[18]. The multidisciplinary team should work in a coordinated way through regular meetings to plan patient care. Programmes of regular staff education

Table 1. The results of investigations performed in all ischemic stroke patients, who were admitted in Siriraj Acute Stroke Unit between May 2005 to May 2007 (n = 503)

Investigations	Number of the pts n (% of all pts.)	Results of investigationn (% of pts. undergoing each investigation)
CT brain	511 (91.25%)	
MRI brain	185 (33.04%)	
MRA brain	149 (26.61%)	
No intracranial stenosis		84 (56.38%)
Intracranial stenosis		65 (43.62%)
MRA neck	22 (3.93%)	
Carotid U/S	183 (32.68%)	
No extracranial stenosis		146 (78.07)
Extracranial stenosis		41 (21.93%)
Trans-esophageal Echocardiography	3 (0.54%)	
Trans-thoracic Echocardiography	204 (36.43%)	
Normal		146 (71.57%)
Abnormal		58 (28.43%)
LVEF <45%		7
Intracardiac clot		4
Wall hypokinesia		25
Other		30
Holter monitoring	5 (0.89%)	
Normal		4 (80%)
Abnormal		1 (20%)



UTI = Urinary tract infection, GI bleeding = Gastrointestinal bleeding

Fig. 4 The bar graph demonstrates the complications of all stroke patients, who were admitted in Siriraj Acute Stroke Unit between May 1997 to May 2007 (n = 2,109)

and training should be provided[18]. The typical components of stroke unit care in stroke unit trials[18] were: (1) medical assessment and diagnosis, including imaging (CT, MRI) and early assessment of nursing and therapy needs; (2) early management, consisting of early mobilization, prevention of complications and treatment of hypoxia, hyperglycemia, pyrexia and dehydration; (3) ongoing rehabilitation, involving coordinated multidisciplinary team care and early assessment of needs after discharge.

Approximately 25 percent of patients may have neurological worsening during the first 24 to 48 hours after stroke. It is difficult to predict which patients will deteriorate[19-21]. The stroke unit will provide close observation of changes of patient's condition and facilitate prompt initiation of medical or surgical interventions. Moreover, the benefits include providing observation and treatment to reduce the likelihood of bleeding complications after the use of thrombolytic therapy, beginning measures to prevent subacute complications, planning for long-term therapies to prevent recurrent stroke and starting efforts to restore neurological function through rehabilitation and good supportive care.

The first stroke unit was established in North America in the 1960s. It was modeled after coronary care units but failed to have any effect on mortality or morbidity[23-25]. In the 1970s, rehabilitation stroke units were created, which involved multidisciplinary teams and staff education, but their effects were not evaluated critically[26]. Non-intensive care acute stroke units supplemented by early mobilization and rehabilitation were created, for the first time, in the 1970s and 1980s

in North America[27,28], the United Kingdom[29] and Scandinavia[30-32]. At first, they focused on diagnosis, prevention of complications, education of staff and research but soon also included early rehabilitation, involvement of family and multidisciplinary team work. Several studies, performed mainly in Europe, demonstrate the utility of comprehensive stroke units in lessening the rates of mortality and morbidity after stroke[33-45]. The Stroke Unit Trialists' Collaboration then verified these results and demonstrated that organized care in stroke units also reduced the rate of both death or institutional care and death or dependency[34]. The positive effects can persist for years. An updated systematic review has confirmed significant reductions in death (3 percent absolute reduction), dependency (5 percent increase in independent survivors) and the need for institutional care (2 percent reduction) for patients treated in a stroke unit, compared with those treated in general wards[8,9]. Moreover, all types of patients, irrespective of gender, age, stroke subtype and stroke severity, appear to benefit from treatment in stroke units[8,9].

The benefits from treatment in a stroke unit are comparable to the effects achieved with intravenous administration of tissue plasminogen activator[46]. In addition, stroke unit care can be given to a broad number of patients regardless of the interval from stroke or severity of the neurological impairments, including patients who cannot be treated with thrombolytic therapy. In the aspect of cost effectiveness, although stroke unit care is more costly than treatment in general neurological or medical wards, it reduces post-acute inpatient care costs[47,48] and thus is cost-effective[13-16].

The SASU, which is a combined acute stroke treatment and rehabilitation, has been established since May 1997, composed of 11 beds and initially served as non-intensive care unit but was changed to provide more comprehensive care in the last 2 years (between 2005 and 2007). The "Stroke fast track" for the hyperacute stroke patients (within 3 hours after stroke onset) was established in 2005 and one bed is always reserved for this group of patients.

The main subtype of stroke patient admitted to SASU was cerebral infarction (86.74 percent) and small vessels disease was the most common stroke mechanism, accounting for 38.97 percent. Risk factors of ischemic stroke patients in the SASU were similar to the other studies, *i.e.* hypertension (61.79 percent), diabetes mellitus (35.47 percent), hyperlipidemia (46.58 percent) and smoking (21.02 percent). In the patients, who had extensive work up for stroke etiology, severe carotid artery stenosis (70-90 percent stenosis) were found in 21.93 percent and intracranial arterial stenosis were found in 43.62 percent, which was equivalent to the other studies in Asia. Intracranial atherosclerosis is an important cause of cerebral ischemia, particularly in Asians, Blacks and Hispanics[49,50]. Compared with the Caucasian population, intracranial arterial stenosis is estimated to cause only 8-10 percent of ischemic stroke[51,52]. However, only small proportion of the patients in our study had MRA or carotid ultrasound performed. Most of the patients, who did not have work up for intracranial stenosis or carotid artery disease, were patients, whose stroke mechanism was thought to be small vessel disease by the neurologists in charge.

Mortality of stroke patients in the SASU was 3.4 percent and the main cause of death was sepsis (55.32 percent). Medical complications of patients in the SASU were recorded as the followings: (a) urinary tract infection (10.15 percent), (b) pneumonia (6.82 percent), (c) upper gastrointestinal hemorrhage (3.99 percent). Only 5 patients in the SASU developed decubitus ulcer, this emphasised the excellent teamwork of nursing staff and physical therapists, who always encourage all patients to mobilize at a very early stage.

The total hospital stay of stroke patients in the SASU was 13.81 days (SD 13.52, ranging from 1-120 days) which was shorter than half of the time spent by stroke patients in general medical wards[53]. The benefit of the reduction of the length of stay is not only reduction of the hospital acquired infection but also increased turnover rate of stroke beds. As the result of increased turnover rate, more stroke patients could be admitted to stroke unit. The shorter length of stay was in part the result of discharge planning aiming for educating the patients and their caregivers in every aspect individually. The patients and their caregivers were all educated early after the admission by the nursing staffs and videotape demonstration about the proper care of stroke patients, early mobilization, stroke prevention and nutrition.

Stroke unit is now accepted as a standard treatment of acute stroke patients and it is proven as effective as treating stroke patients with a thrombolytic agent in term of reducing mortality and morbidity[6,7]. The cost of setting up a stroke unit is much cheaper than the cost of giving thrombolytic therapy to an acute stroke patient. In Thailand, however, the concept of stroke unit is still not generalized and to date, only

tertiary care centers have successfully established an acute stroke unit. The major reasons are the lack of recognization of a stroke unit's important by general physicians and limited resources. The authors encourage the establishment of the non-intensive organized stroke units countrywide which comprises of a multidisciplinary team approach, more appropriate investigations, early and more intensive mobilization and rehabilitation and prompt detection of complications. This approach will lead to better prognosis for these patients, both in the acute stage and in the long term.

Potential conflicts of interest

None.

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การศึกษาลักษณะพื้นฐานภาวะแทรกซ้อนและระยะเวลาการนอนโรงพยาบาลในผู้ป่วยโรคหลอดเลือดสมองที่เข้ารับการรักษาในหอผู้ป่วยวิกฤตเฉพาะโรคหลอดเลือดสมองโรงพยาบาลศิริราช ตั้งแต่ปี พ.ศ. 2540 ถึงปี พ.ศ. 2550

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ภูมิหลัง: *โรคหลอดเลือดสมองจัดเป็นปัญหาทางสาธารณสุขที่สำคัญยิ่ง และเป็นปัญหาที่เป็นเหตุของการเสียชีวิตและทุพพลภาพอันดับต้นๆ ข้อมูลจากการทำการศึกษาวิจัยในปัจจุบันพบว่าการรักษาด้วยยาสลายลิ่มเลือด ยาต้านเกร็ดเลือดและการดูแลผู้ป่วยในหอผู้ป่วยวิกฤตเฉพาะโรคหลอดเลือดสมอง (stroke unit) มีผลทำให้ผลการดูแลรักษาผู้ป่วยโรคหลอดเลือดสมองดีกว่าการรักษาในอดีต ในประเทศไทยมีการก่อตั้งหอผู้ป่วยวิกฤตเฉพาะโรคหลอดสมองแห่งแรกที่โรงพยาบาลศิริราช ตั้งแต่เดือนพฤษภาคม พ.ศ. 2540 โดยมีวัตถุประสงค์เพื่อเป็นต้นแบบของการพัฒนาการดูแลผู้ป่วยโรคหลอดเลือดสมองในประเทศไทย*

วัตถุประสงค์: *เพื่อศึกษาลักษณะพื้นฐาน ภาวะแทรกซ้อนและระยะเวลา การนอนโรงพยาบาลในผู้ป่วยโรคหลอดเลือดสมองที่เข้ารับการรักษาในหอผู้ป่วยวิกฤตเฉพาะโรคหลอดเลือดสมอง โรงพยาบาลศิริราช ตั้งแต่เดือนพฤษภาคม พ.ศ. 2540 ถึงเดือนพฤษภาคม พ.ศ. 2550 ซึ่งเป็นระยะเวลาช่วง 10 ปีแรกหลังการก่อตั้งหอผู้ป่วยวิกฤตเฉพาะโรคหลอดสมองแห่งแรกที่โรงพยาบาลศิริราช*

วัสดุและวิธีการ: *เป็นการศึกษาข้อมูลย้อนหลัง โดยศึกษาลักษณะพื้นฐาน อาการทางคลินิก ผลการตรวจทางห้องปฏิบัติการ ภาวะแทรกซ้อนและระยะเวลาการนอนโรงพยาบาลของผู้ป่วย โรคหลอดเลือดสมองทุกรายที่เข้ารับการรักษาในหอผู้ป่วยวิกฤต เฉพาะโรคหลอดเลือดสมองโรงพยาบาลศิริราช ตั้งแต่เดือนพฤษภาคม พ.ศ. 2540 ถึงเดือนพฤษภาคม พ.ศ. 2550 การวิเคราะห์ทางสถิติทำโดยใช้โปรแกรม SPSS version 11 ในการประมวลผล โดยวิเคราะห์ข้อมูลเชิงปริมาณด้วย ค่าเฉลี่ย, ค่าต่ำสุดและค่าสูงสุด ส่วนข้อมูลเชิงคุณภาพใช้คำนวณค่าทางสถิติเป็นจำนวนและร้อยละ*

ผลการศึกษา: *ได้ทำการศึกษาผู้ป่วย 2,109 ราย ที่เข้ารับการรักษาในหอผู้ป่วยวิกฤตเฉพาะโรคหลอดเลือดสมองโรงพยาบาลศิริราชในช่วงเวลา 10 ปี ผู้ป่วยที่เข้ารับการรักษามีอายุเฉลี่ย 65.35 ปี เป็นผู้ป่วยโรคหลอดเลือดสมองตีบ 1,799 ราย (86.7%) และผู้ป่วยโรคหลอดเลือดสมองแตก 310 ราย (13.26%) กลไกการเกิดของโรคหลอดเลือดสมองตีบที่พบได้บ่อยที่สุดได้แก่ การตีบของหลอดเลือดขนาดเล็กโดยคิดเป็น 38.96% ตำแหน่งของโรคหลอดเลือดสมองตีบที่พบได้บ่อยที่สุดได้แก่ ในบริเวณของ middle cerebral artery คิดเป็น 77.14% ปัจจัยเสี่ยงที่พบในผู้ป่วยได้แก่ โรคความดันโลหิตสูง 61.79% โรคเบาหวาน 35.47% ไขมันในเลือดสูง 46.58% สูบบุหรี่ 21.02% โรคหลอดเลือดตีบบริเวณอื่นๆ 23.74% อัตราการตายในผู้ป่วยทั้งหมด 3.4% โดยสาเหตุการตายที่พบบ่อยได้แก่ การติดเชื้อ ระยะเวลาการนอนโรงพยาบาลโดยเฉลี่ยอยู่ที่ 13.81 วัน ตั้งแต่เดือนสิงหาคม พ.ศ. 2548 มีการเริ่มให้ยาสลายลิ่มเลือดในผู้ป่วยโรคหลอดเลือดสมองตีบระยะเฉียบพลันที่มาถึง โรงพยาบาลภายในระยะเวลา 3 ชั่วโมง ตั้งแต่เดือนสิงหาคม พ.ศ. 2548 ถึง เดือนพฤษภาคม พ.ศ. 2550 มีผู้ป่วยได้รับยาสลายลิ่มเลือดทั้งหมด 30 คน มีอายุเฉลี่ย 70.7 ปี มีค่าเฉลี่ยของ National Institutes of Health Stroke Scale 14.27 พบผู้ป่วยที่มีเลือดออกในสมองหลังจากได้รับ*

ยาสลายลิ่มเลือดทั้งหมด 8 คน (26.67%) โดยเป็นเลือดออกในสมองที่มีอาการรุนแรง 3 ราย (10%)
***สรุป**: มาตรฐานของหอผู้ป่วยวิกฤตเฉพาะโรคหลอดเลือดสมองแห่งแรกที่โรงพยาบาลศิริราชไม่ได้แตกต่างจากหอผู้ป่วยวิกฤตเฉพาะ โรคหลอดเลือดสมองในต่างประเทศ การดูแลผู้ป่วยในหอผู้ป่วยวิกฤตเฉพาะโรคหลอดเลือดสมองมีผลลด อัตราการตายและลดระยะเวลา การนอนโรงพยาบาลเมื่อเปรียบเทียบกับตัวเลขจากการศึกษาในอดีต*