Spontaneous Craniocervical Arterial Dissection: A Clinical and Vascular Neuroimaging Study

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Background: *Spontaneous craniocervical arterial dissection (SCAD) is an important cause of stroke in the young and middle-aged population. However, clinical data of SCAD is limited in Thailand. This present study aims to describe the clinical profiles of SCAD in a tertiary care center in Thailand.*

Material and Method: *All SCAD patients admitted to King Chulalongkorn Memorial Hospital between January 1997 and October 2011 were enrolled. All of the patients fulfilled vascular imaging diagnostic criteria for SCAD. Clinical profiles, associated risk factors, vascular neuroimaging patterns, treatments, and outcomes were analyzed by SPSS program version 17.*

Results: *Fifty patients with SCAD were identified (0.5% of total hospitalized ischemic cerebrovascular disease and subarachnoid hemorrhage (SAH) patients). SCAD was found in 1.6% of patients under the age of 45 years. Eighty-six percent of the patients were diagnosed during the last five years of this present study period. Internal carotid artery dissection (ICAD) and vertebral artery dissection (VAD) were detected in 42% and 58% respectively. The mean age was 48.3±15.3 years. Atherosclerotic risk factors included hypertension (16%), diabetes mellitus (24%), and dyslipidemia (28%). History of previous minor head injury and migraine were encountered in 8% and 4% respectively. Headache was detected in 80% of the cases. Localized headache was observed in 64% of the cases. Diffuse headache due to SAH was detected in 14% of the cases. Neurological syndromes at presentation were ischemic stroke (72%), transient ischemic attack (TIA) (8%), and SAH (16%). Pathognomonic vascular neuroimaging patterns of dissection included wall hematoma (36%), flame-shaped appearance (28%), dissecting pseudoaneurysm (24%), and intimal flap (8%). Other vascular imaging features included dissecting vessel stenosis (58%) and dissecting vessel occlusion (18%). Treatment consisted of anticoagulants (60%), antiplatelets (10%), surgical intervention (22%), and conservative management (8%). Neurological outcomes at discharge with MRS 0-3 were 72%. No recurrent dissection or recurrent cerebrovascular events were observed during the six-month follow-up period. In this present study, significant differences between ICAD and VAD in terms of percentage of SAH, severity, and outcomes were observed.*

Conclusion: *SCAD results in diverse cerebrovascular events such as ischemic stroke, TIA, and SAH in the young and middle-aged population. Advances in vascular neuroimaging play a crucial role in the diagnosis of SCAD. Prompt management is essential for SCAD with a rather favorable outcome.*

Keywords: *Cerebrovascular disease, Craniocervical artery dissection*

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Spontaneous craniocervical arterial dissection (SCAD) is a tearing in the wall of a major neck artery in the absence of trauma. With early diagnosis and prompt appropriate treatment, patients with SCAD have a favorable outcome[1]. SCAD was previously an underrecognized cause of cerebrovascular disease in the young and middle-aged adults[2-4]. In the late 1970s, the syndrome was systematically studied and angiographic findings of the dissecting vessel were documented[1,2]. Advances in non-invasive vascular neuroimaging techniques have contributed to the increasing diagnosis of the syndrome[5]. Considering the limited data on SCAD available in Thailand, the present study was designed to determine the percentage of SCAD among ischemic cerebrovascular disease and subarachnoid hemorrhage, clinical profiles, associated risk factors, vascular imaging features, treatment strategies and outcomes in patients with SCAD admitted in a tertiary care center in Thailand.

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Material and Method

Medical recordings were searched from databases of King Chulalongkorn Memorial Hospital (KCMH) between January 1997 and October 2011. Keywords were "Carotid artery dissection", "Vertebral artery dissection", "Cerebral artery dissection" and "Craniocervical arterial dissection". SCAD was established by at least one method of vascular imaging studies that included magnetic resonance imaging/ magnetic resonance arteriography (MRI/MRA), computerized tomographic angiography (CTA), digital subtraction angiography (DSA) and carotid duplex ultrasonography (CDUS). The diagnostic imaging features for dissection include intimal flap, intramural hematoma, flame-shaped tapering appearance, and dissecting pseudoaneurysm. Other suggestive imaging features of SCAD include long tapered luminal stenosis or occlusion located at a common site of dissection. Patients were excluded if they had a previous history of major head or neck injury that caused neurological deficit or loss of consciousness. Baseline data included age, sex, and risk factors for dissection (minor injury due to massage or coughing, migraine, connective tissue disease such as Ehlers-Danlos syndrome, Marfan's syndrome, autosomal dominant polycystic kidney disease, and cerebrovascular risk factors). Clinical profiles included cerebrovascular syndrome (ischemic stroke, TIA or SAH), associated signs/symptoms (headache, tinnitus, Horner's syndrome, cranial neuropathy, cervical myelopathy, or radiculopathy). Mode of treatment, severity of the syndrome (as measured by National Institute of Health Stroke Scale-NIHSS score) at admission and discharge, outcomes (as measured by Modified Rankin Scale (MRS) score-which was graded into full recovery (MRS 0), mild to moderate disability (MRS 1-3) and severe disability (MRS 4-5)[6]) and recurrence of cerebrovascular event in a 6 month follow-up period were collected. All descriptive data and comparison of various clinical and neuroimaging profiles between ICAD and VAD were analyzed by SPSS program version 17. Non-parametric statistics (Chi-square test, Fisher's exact test, and Mann-Whitney U test) were applied to test the different between ICAD and VAD group. $P<0.05$ was set for significant.

Ethical consideration

The institution review board of the Faculty of Medicine, Chulalongkorn University, Bangkok Thailand, approved the present study.

Results

During the study period, 8,605 patients were identified as having had ischemic cerebrovascular events and 1,356 patients were identified as having had subarachnoid hemorrhage. SCAD was detected in 50 patients, majority of which was VAD (29 patients, 58%). Forty-three out of the 50 patients (86%) were diagnosed during the last five years of the study. SCAD were found in 0.5% of all ischemic cerebrovascular disease and 0.6% of all SAH. The percentage of SCAD among these patients was 0.5% in all age groups and 1.6% in the patients under the age of 45 years. The mean age of patients was 48.3±15.3 years. Men were slightly more common than women. Cerebrovascular risk factors ranged from 16% to 28%. Previous history of neck massage and migraine were noted in four patients (8%) and two patients (4%) respectively. The demographic data of SCAD are summarized in Table 1. No statistical difference in demographic data between ICAD group and VAD group was observed.

Table 1. Demographic data of internal carotid artery dissection and vertebral artery dissection

	ICAD	VAD	Total	p-value
Number (%)	21 (42.0%)	29 (58.0%)	50	
Age (mean ± SD)	49.9±18.5	47.1±12.8	48.3±15.3	0.558
Female (%)	9 (42.9%)	11 (37.9%)	20 (40.0%)	0.726
Risk factors				
DLP	7 (33.3%)	7 (24.1%)	14 (28.0%)	0.475
DM	6 (28.6%)	6 (20.7%)	12 (24.0%)	0.520
HT	3 (14.3%)	5 (17.2%)	8 (16.0%)	1.000*
Minor trauma	2 (9.5%)	2 (6.9%)	4 (8.0%)	1.000*
Migraine	1 (4.8%)	1 (3.4%)	2 (4.0%)	1.000*

* Fisher's exact test

ICAD = internal carotid artery dissection; VAD = vertebral artery dissection; DLP = dsylipidemia; DM = diabetes; HT = hypertension

Ischemic cerebrovascular events were the most common neurological presentation, followed by SAH and TIA. Only two patients (4%) presented with headache without other neurological syndromes. Localized headache in VAD was more common in the occipital area and neck while in ICAD it was more common in the temporal area on the side of the dissection. Diffuse headache was observed in SAH. Latency from headache to neurological manifestations was within one day in 36 patients (72%), one week, and two weeks in two patients (4%) and one patient (2%) respectively. No other associated symptoms were observed in this present study. The presenting syndromes of SCAD are summarized in Table 2.

Vascular neuroimaging techniques included MRI/MRA in 38 patients (76%), DSA in 13 patients (26%), CTA in six patients (12%), and CDUS in three patients (6%). Most of the patients had unilateral dissection and only three patients (6%) had bilateral dissection. Right side dissection was more common than left side dissection. The most common dissecting site in ICAD and VAD were cervical (C1) and

Table 2. Presenting syndromes of spontaneous craniocervical arterial dissection of internal carotid artery and vertebral artery (n = 50)

	ICAD	VAD	Total	p-value
Neurological presentation				
Ischemic stroke	17 (81.0%)	19 (65.5%)	36 (72.0%)	0.230
SAH	1 (4.8%)	7 (24.1%)	8 (16.0%)	0.117*
TIA	2 (9.5%)	2 (6.9%)	4 (8.0%)	1.000*
No neurodeficit	1 (4.8%)	1 (3.4%)	2 (4.0%)	1.000*
Headache	14 (66.7%)	25 (86.2%)	39 (78.0%)	0.166*
Occipital	8 (38.1%)	14 (48.3%)	22 (44.0%)	0.474
Temporal	7 (33.3%)	11 (37.9%)	18 (36.0%)	0.738
Neck	3 (14.3%)	8 (27.6%)	11 (22.0%)	0.319*
Diffuse	1 (4.8%)	6 (20.7%)	7 (14.0%)	0.215*

* Fisher's exact test

ICAD = internal carotid artery dissection; VAD = vertebral artery dissection; SAH = subarachnoid hemorrhage; TIA = transient ischemic attack

Table 3. Vascular neuroimaging features of internal carotid artery dissection and vertebral artery dissection

	ICAD	VAD	Total	p-value
Side				0.584*
Right	10 (47.6%)	18 (62.1%)	28 (56.0%)	
Left	9 (42.9%)	10 (34.5%)	19 (38.0%)	
Bilateral	2 (9.5%)	1 (3.4%)	3 (6.0%)	
Internal carotid artery dissecting site				
Cervical (C1)	20 (95.2%)			
Intracranial (C2-C7)	1 (4.8%)			
Vertebral artery dissecting site				
Osseous (V1)		8 (27.6%)		
Foraminal (V2)		1 (3.4%)		
Extraspinal (V3)		6 (20.7%)		
Intradural (V4)		14 (48.3%)		
Pathognomonic features of dissection				
Wall hematoma	8 (38.1%)	10 (34.5%)	18 (36.0%)	0.793
Flame-shaped vessel	8 (38.1%)	6 (20.7%)	14 (28.0%)	0.176
Pseudoaneurysm	1 (4.8%)	11 (37.9%)	12 (24.0%)	0.007
Intimal flap	3 (14.3%)	1 (3.4%)	4 (8.0%)	0.297*
Other suggestive features of dissection				
Stenosis	13 (61.9%)	16 (55.2%)	29 (58.0%)	0.634
Occlusion	7 (33.3%)	2 (6.9%)	9 (18.0%)	0.025*

* Fisher's exact test

ICAD = internal carotid artery dissection; VAD = vertebral artery dissection

intradural (V4) respectively. The most common pathognomonic vascular neuroimaging feature was intramural hematoma. The vascular neuroimaging features of SCAD are summarized in Table 3 and the pathognomonic features of the dissection are demonstrated in Fig. 1-4.

Anticoagulant was the most common medical treatment prescribed in patients with SCAD. Eleven patients (22%) underwent interventional treatment. Intimal flap fenestration was performed in two ICAD patients. Superficial temporal artery/middle cerebral artery bypass was performed in one patient who had bilateral ICAD, which caused complete occlusion of the bilateral internal carotid artery. Craniotomy with trapping aneurysm (4 patients), coil embolization (3 patients), and angiogram with stent (1 patient) were performed in VAD patients who had dissecting pseudoaneurysm.

Severity of ischemic cerebrovascular syndrome as measured by NIHSS at admission and at discharge were significantly higher (more severe) in patients with ICAD than VAD. Functional outcome

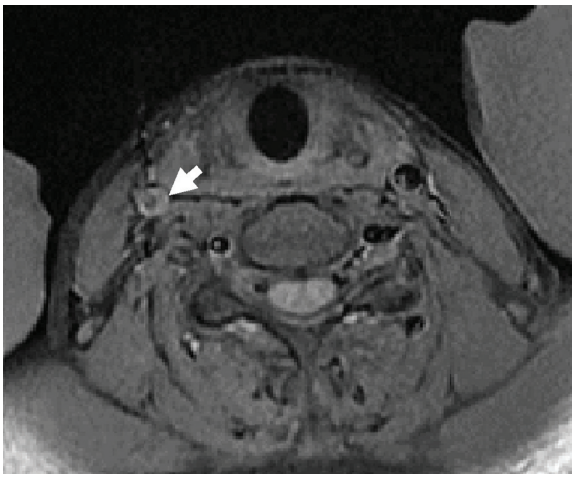

Fig. 1 Magnetic resonance imaging T1-weighted image with fat suppression technique showing crescentric hypersignal intensity due to intramural hematoma (arrow) at cervical segment (C1) in right internal carotid arterial dissection.

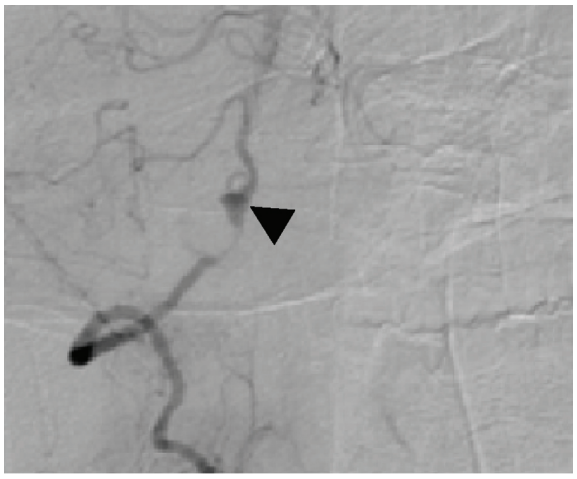

Fig. 3 Digital subtraction angiography showing fusiform-shaped dissecting pseudoaneurysm (arrow head) at intracranial segment (V4) in right vertebral arterial dissection.

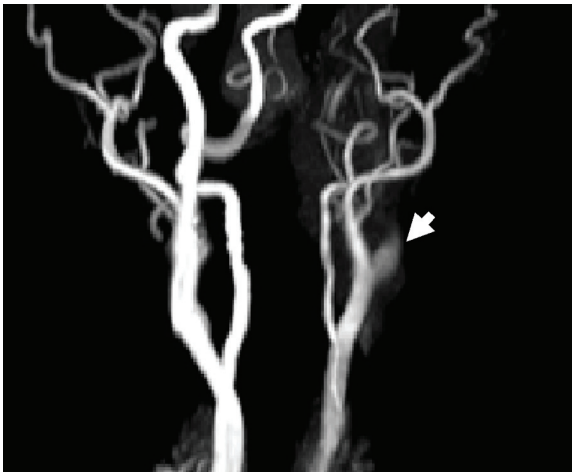

Fig. 2 Magnetic resonance angiography showing flame-shaped stenosis (arrow) at cervical segment (C1) in left internal carotid arterial dissection.

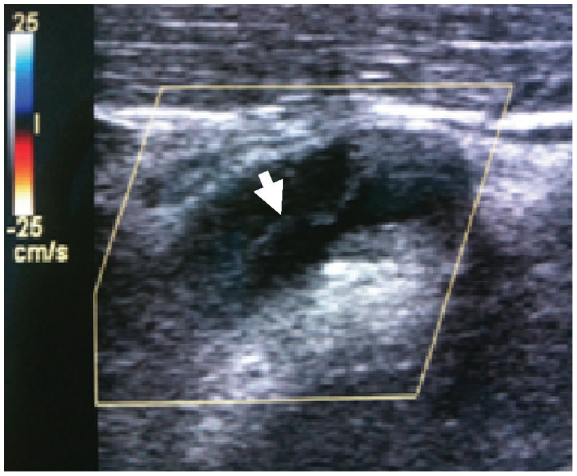

Fig. 4 Duplex ultrasonography showing intimal flap (arrow) at cervical segment (C1) in left internal carotid arterial dissection.

Table 4. Treatments and outcomes in internal carotid artery dissection and vertebral artery dissection

	ICAD	VAD	Total	p-value
Treatment				
Anticoagulant	15 (71.4%)	15 (51.7%)	30 (60.0%)	
Intervention	3 (14.3%)	8 (24.6%)	11 (22.0%)	
Antiplatelet	1 (4.8%)	4 (13.8%)	5 (10.0%)	
Conservative	2 (9.5%)	2 (6.9%)	4 (8.0%)	
NIHSS[1] (median) (min, max)	9 (0, 17)	2 (0, 8)	4.5 (0, 17)	0.003[#]
NIHSS[2] (median) (min, max)	5 (0, 18)	2 (0, 6)	3 (0, 18)	0.007[#]
Outcome (MRS score)				
Full recovery (MRS 0)	2 (9.5%)	3 (10.3%)	5 (10.0%)	1.000*
Mild to moderate (MRS 1-3)	9 (42.9%)	22 (75.9%)	31 (62.0%)	0.018
Severe (MRS 4-5)	10 (47.6%)	4 (13.8%)	14 (28.0%)	0.009

[1] NIHSS at admission, [2] NIHSS score at discharge, * Fisher's exact test, [#] Mann-Whitney U test
ICAD = internal carotid artery dissection; VAD = vertebral artery dissection; NIHSS = national institutes of health stroke scale; MRS = modified rankin scale

as measured by MRS score was significantly more favorable in VAD. The treatment and outcome of SCAD are summarized in Table 4.

Thirty-eight patients (76%) had at least a six-month follow-up period. Eight patients were lost to follow-up and four patients had no recorded data. No patient had recurrent dissection or recurrent cerebrovascular events during the six-month follow-up period.

Discussion

The increased diagnosis of SCAD in this present study showed the same trend as in the Western study. Eighty-six percent of cases in this present study were diagnosed in the last five years of the study period, while 96% of the cases in a large European study were diagnosed in the last 10 years of the study[4]. The present study demonstrated a low percentage of SCAD among adults with ischemic cerebrovascular disease (0.5%) as compared to the Western countries (2%)[1]. A stroke in the young (age less than 45 years) and middle-aged, was much lower in percentage of SCAD in this series (1.6%) than in the Western countries (10-25%)[1]. The percentage of SCAD among SAH patients was reported only in autopsy studies from Japan (4.5%)[7] which may not be comparable to this study (0.6%). No data regarding the percentage of SCAD among clinical SAH in either European or Asian series was found.

The high percentage of VAD (58%) compared to ICAD (42%) in this present study was comparable with other Asian countries such as Japan[8] and Taiwan[9] which observed VAD of about 70% and ICAD of about 30% of SCAD. The Western countries more ICAD (60%) was encountered than VAD (40%)[1,3,4]. Mean age in this present study was about 48 years and men were slightly predominant (60%), which was comparable to other Asian studies. The mean age of about 45 years in Western countries[3,4] was slightly lower than in Asian countries, but men were also predominant, as in Asian countries[4].

The most common neurological presentation in this present study was ischemic cerebrovascular events (80% of patients). However, a high percentage of SAH (16%) was also observed in this present study. SAH was more commonly observed in VAD (7 patients, 24.1%) compared to ICAD (1 patient, 4.8%). The high percentage of SAH and preferential occurrence of SAH in VAD was comparable to the study from Taiwan[9] (30% of SCAD presented with SAH, 40% in VAD and 4.5% in ICAD), whereas studies from Western countries had a much lower percentage of SAH and occurred more commonly in ICAD (0.7% of SCAD presented with SAH, 1% in ICAD and 0.3% in VAD)[4].

Headache was a common associated symptom and an important clue to the diagnosis. The localized pain syndrome in this present series was associated with ischemic events in SCAD, which was comparable to other series[10]. The higher percentage of diffuse headache in this series (14%) reflected the high percentage of SAH among the studied patients. Other associated signs and symptoms[1,11-13] were not encountered in this series.

From previous studies, history of minor head or neck trauma were found in approximately 30% of

SCAD patients and cardiovascular risk factors ranged from 15 to 20%[1,4,14]. Some studies suggest the abnormalities associated with connective tissue disorder are also associated with SCAD[1,14,15]. In this present study, previous history of minor trauma was observed only in 8% of the study whereas cardiovascular risk factors were found in comparable percentage with Western studies[4]. No connective tissue disorder was found in this series.

Multiple dissection was less common in this series (6%) as compared with 10 to 25% of multiple dissection in Western countries[1,3,4]. The most common dissection site in ICAD was at cervical segment (C1) and VAD was at intracranial segment (V4), which was comparable with other studies from Asian countries[8,9]. In Western countries, the most common site of dissection in ICAD was also at cervical segment (C1) while the most common site of dissection in VAD was at V1 and V3 segment. Pathognomonic vascular neuroimaging features were more commonly detected in Western studies[4] due to more advances in vascular neuroimaging techniques.

Treatment of acute ischemic cerebrovascular syndrome and TIA in SCAD is anticoagulants or antiplatelets. Warfarin with INR level 2-3 is recommended to prevent distal embolization[16]. However, due to the possibility of hemorrhagic complications, patients with intracranial dissection or patients with a large area of infarction were recommended for antiplatelet treatment. In this study, most patients with ischemic cerebrovascular event were treated with anticoagulants (60%). In patients with progressive ischemic syndrome (despite appropriate anticoagulant therapy) or patients with dissecting pseudoaneurysm resulting in SAH or compression to nearby neural structures, endovascular intervention or surgical procedures such as transarterial embolization or surgical clipping are recommended[1,3,9]. In this study, 11 patients (22%) underwent surgical or endovascular intervention.

In this study, the outcome defined by MRS scale 0-3, which was accepted as a favorable outcome in SCAD, were found in 72% of the patients (86.2% in VAD and 52.4% in ICAD). No mortality rate and no recurrent dissection occurred during the 6 months follow-up period. In Western countries, favorable outcome with MRS 0-3 was approximately 80% (75% of ICAD and 90% of VAD). However, the mortality rate and the recurrent dissection were detected in about 5% and 2% of the patients respectively[1,4,13].

Conclusion

SCAD is an important cause of diverse cerebrovascular events in young and middle-aged patients. SCAD is an increasingly detected cause of stroke due to the recognition of the condition and advances in noninvasive neurovascular imaging techniques. SCAD should be suspected in patients presenting with localized headache or neck pain in association with cerebrovascular disease, transient ischemic attack, or SAH especially in the young and middle-aged population. With prompt diagnosis and appropriate management, SCAD has a favorable outcome. In summary, the results of this present study were comparable to the data from other Asian countries, which were slightly different from Western countries.

Potential conflicts of interest

None.

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ภาวะฉีกเซาะของหลอดเลือดแดงบริเวณศีรษะและลำคอที่เกิดขึ้นเอง: การศึกษาลักษณะทางคลินิกและภาพวินิจฉัยหลอดเลือด

โชติวุฒิ ตันศิริสิทธิกุล, กัมมันต์ พันธุมจินดา

ภูมิหลัง: *ภาวะฉีกเซาะของหลอดเลือดแดงบริเวณศีรษะและลำคอที่เกิดขึ้นเอง (spontaneous craniocervical arterial dissection: SCAD) เป็นสาเหตุที่สำคัญของโรคหลอดเลือดสมองในผู้ป่วยอายุน้อยจนถึงวัยกลางคน ข้อมูลการศึกษาภาวะ SCAD ยังมีน้อยในประเทศไทย วัตถุประสงค์ของการศึกษานี้เพื่อศึกษาถึงลักษณะทางคลินิกของภาวะ SCAD จากศูนย์การแพทย์ระดับตติยภูมิในประเทศไทย*

วัสดุและวิธีการ: *ผู้นิพนธ์ทำการรวบรวมข้อมูลภาวะ SCAD จากฐานข้อมูลของโรงพยาบาลจุฬาลงกรณ์ ระหว่างเดือนมกราคม พ.ศ. 2540 ถึง เดือนตุลาคม พ.ศ. 2554 เกี่ยวกับลักษณะทางคลินิก, ปัจจัยเสี่ยง, ลักษณะทางภาพวินิจฉัย, การรักษา และพยากรณ์โรค โดยวิเคราะห์ทางสถิติด้วยโปรแกรม SPSS version 17*

ผลการศึกษา: *พบผู้ป่วยภาวะ SCAD จำนวน 50 ราย คิดเป็น ร้อยละ 0.5 ของผู้ป่วย ischemic cerebrovascular disease และ subarachnoid hemorrhage (SAH) และคิดเป็น ร้อยละ 1.6 ของผู้ป่วยที่อายุต่ำกว่า 45 ปี ร้อยละ 86 ของผู้ป่วยได้รับการวินิจฉัยใน 5 ปีสุดท้ายของการศึกษา พบผู้ป่วย Internal carotid artery dissection (ICAD) ร้อยละ 42 และผู้ป่วย vertebral artery dissection (VAD) ร้อยละ 58 อายุเฉลี่ยของผู้ป่วย 48.3±15.3 ปี ปัจจัยเสี่ยงของโรคหลอดเลือดสมองพบความดันโลหิตสูง ร้อยละ 16, เบาหวาน ร้อยละ 24, ไขมันในเลือดสูง ร้อยละ 28 ประวัติ minor head injury ร้อยละ 8 และประวัติ migraine ร้อยละ 4 อาการปวดศีรษะพบได้ร้อยละ 80 โดยเป็นปวดศีรษะเฉพาะที่ ร้อยละ 64 และปวดทั้งศีรษะจาก SAH ร้อยละ 14 อาการทางระบบประสาทพบอาการของภาวะสมองขาดเลือด (ischemic stroke) ร้อยละ 72, ภาวะสมองขาดเลือดชั่วคราว (transient ischemic attack) ร้อยละ 8 และภาวะ SAH ร้อยละ 16 การตรวจภาพวินิจฉัยหลอดเลือดพบลักษณะที่ช่วยในการวินิจฉัยคือ wall hematoma ร้อยละ 36, flame-shaped appearance ร้อยละ 28, dissecting pseudoaneurysm ร้อยละ 24 และ intimal flap ร้อยละ 8 ลักษณะอื่น ๆ ที่พบได้แก่ dissecting vessel stenosis ร้อยละ 58 และ dissecting vessel occlusion ร้อยละ 18 ผู้ป่วยได้รับการรักษาด้วย anticoagulant ร้อยละ 60, antiplatelet ร้อยละ 10, surgical intervention ร้อยละ 22 และ conservative treatment ร้อยละ 8 ผู้ป่วยส่วนใหญ่มีผลการรักษาค่อนข้างดีโดยพบว่า ร้อยละ 72 มี modified Rankin scale (MRS) score 0-3 ไม่พบการเกิด dissection ซ้ำและไม่พบการกลับเป็นซ้ำของโรคหลอดเลือดสมองเมื่อติดตามไปเป็นระยะเวลา 6 เดือนในการศึกษานี้พบความแตกต่างระหว่างผู้ป่วย ICAD กับ VAD อย่างมีนัยทางสถิติในแง่ของร้อยละของผู้ป่วย SAH, ความรุนแรง และผลการรักษา*

สรุป: *ภาวะ SCAD เป็นภาวะที่พบไม่บ่อย ผู้ป่วยสามารถมาพบแพทย์ได้ด้วยภาวะ ischemic stroke, TIA หรือ SAH โดยเฉพาะในผู้ป่วยอายุน้อย การวินิจฉัยอาศัยประวัติอาการ, อาการที่พบร่วม, ปัจจัยเสี่ยง และการตรวจภาพวินิจฉัยหลอดเลือด การวินิจฉัยภาวะ SCAD ได้ตั้งแต่เริ่มแรก รวมทั้งการได้รับการรักษาที่เหมาะสม มักทำให้ผู้ป่วยมีพยากรณ์โรคที่ค่อนข้างดีในระยะยาว*