นิพนธ์ต้นฉบับ ▪ Original Article

ข้อบ่งชี้และแนวโน้มของโรคหลอดเลือดสมองและไขสันหลังที่ได้รับการตรวจด้วยการฉีดสีในโรงพยาบาลศรีนครินทร์

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Indications of Neurovascular Diseases and Trend, in Srinagarind Hospital: Angiographic Base

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หลักการและวัตถุประสงค์: เพื่อศึกษาข้อบ่งชี้และแนวโน้มของโรคหลอดเลือดสมองและไขสันหลังที่ต้องได้รับการฉีดสีหลอดเลือดในโรงพยาบาลศรีนครินทร์

วิธีการศึกษา: การศึกษาย้อนหลังข้อมูลผู้ป่วยที่ได้รับการฉีดสีหลอดเลือดสมองและไขสันหลังครั้งแรกในช่วงปี พ.ศ. 2557-2559 โดยศึกษาอายุ เพศ ข้อบ่งชี้ในการฉีดสีหลอดเลือด และผลการวินิจฉัยจากภาพฉีดสีหลอดเลือด รวมทั้งแสดงแนวโน้มภายในสามปี

ผลการศึกษา: ผู้ป่วยจำนวน 739 ราย ที่ได้รับการตรวจด้วยการฉีดสีหลอดเลือดสมองและไขสันหลังด้วยวิธีมาตรฐานในช่วงปี พ.ศ. 2557-2559 มีอายุเฉลี่ย 46.33 ปี ข้อบ่งชี้ที่พบมากที่สุด คือ ผู้ป่วยที่มาด้วยภาวะเลือดออกใต้เยื่อหุ้มสมองชั้นกลาง ร้อยละ36.54 ข้อบ่งชี้ลำดับถัดมา คือ ตาโปนแดง ร้อยละ 13.40 กลุ่มโรคทางหลอดเลือดสมองที่ได้รับการวินิจฉัยมากที่สุด 5 อันดับแรก ได้แก่ หลอดเลือดสมองโป่งพอง ร้อยละ 37.61 หลอดเลือดสมองสร้างผิดปกติ ร้อยละ17.59 ไม่พบรอยโรคหลอดเลือดสมอง ร้อยละ 11.31 หลอดเลือดสมองบาดเจ็บจากอุบัติเหตุ ร้อยละ 11.23 และ รูรั่วหลอดเลือดสมองบริเวณเยื่อหุ้มสมอง ร้อยละ 7.98 ส่วน 4 กลุ่มโรคที่พบน้อย ได้แก่ หลอดเลือดบริเวณศีรษะและลำคอสร้างผิดปกติ ร้อยละ 7.58 หลอดเลือดสมองตีบอุดตัน ร้อยละ 3.92 โรคหลอดเลือดหรือเนื้องอกไขสันหลัง ร้อยละ1.62 และโรคหลอดเลือดสมองเด็ก ร้อยละ 0.14

สรุป: ข้อบ่งชี้และแนวโน้มของโรคหลอดเลือดสมองในภูมิภาคตะวันออกเฉียงเหนือมีความหลากหลายทั้งอาการแสดงและกลุ่มโรค ในสถาบันของเรามีแนวโน้มของโรคหลอดเลือดและไขสันหลังสูงขึ้นตามการพัฒนาของทีมผู้ให้การรักษาและคุณภาพของระบบส่งต่อผู้ป่วย

Background and Objective: To evaluate the frequency of indication of the neurovascular diseases and trends in Srinagarind hospital, the northeastern of Thailand by angiographic based

Material and Methods: This was a descriptive retrospective study of patients who underwent first diagnostic cerebral or spinal angiography, listed in the database of intervention neuroradiology unit between 2014-2016. We interested in age, sex, indication for diagnostic cerebral and spinal angiography and disease diagnosis classified by angiographic based. We described the trends of diseases in 3 years.

Results: 739 patients were performed diagnostic angiography between 2014-1016 with mean age of 46.33 years. The most frequent indication for diagnostic angiography is subarachnoid hemorrhage (36.54%), followed by eye symptoms (13.40%). Five most common diagnosis by angiographic based were intracranial aneurysm (37.61%), intracranial neurovascular malformations (17.59%), negative diagnostic angiogram (11.31%), traumatic neurovascular disease (11.23%) and intracranial DAVFs (7.98%). Four uncommon diseases were head/neck tumor and vascular malformations (7.58%), ischemic and steno-occlusive disease (3.92%), spinal vascular disease and spine/spinal cord tumor (1.62%) and pediatric neurovascular disease (0.14%), r espectively.

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คำสำคัญ: การฉีดสีหลอดเลือดสมอง, การฉีดสีหลอดเลือดไขสันหลัง, โรคหลอดเลือดสมอง

Conclusion: Overall indication and trends neurovascular disease in northeastern of Thailand are variable among clinical presentation and disease classification. In our institute, trends of the common and uncommon diseases seem to be increased, related to development capacity of our multidisciplinary teams and quality of regional referral systems.

Key words: Cerebral Angiogram, Spinal angiogram, Neurovascular disease

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Introduction

Despite of development in non-invasive imaging, cerebral angiography (CA) remains the gold standard in evaluating and treating cerebrovascular diseases.[1-3] Several advances in endovascular technology and techniques have been brought the field of endovascular treatment of extracranial and intracranial cerebrovascular diseases to the forefront.[4] As in the Northeastern of Thailand, CA has been performed for many years, from conventional CA, 2D-diagnostic cerebral angiography to 3D-diagnostic angiography. In the era of 3D-diagnostic angiography with advanced endovascular therapy, interventional neuroradiology has evolved with increasing numbers of 3D-anngiography.

As a referral center of Northeast of Thailand, our institute plays a role as the center of neurovascular disease. Kitkhuandee et al. had described cerebral angiographic finding of non-traumatic subarachnoid hemorrhage (SAH) in Northeastern patients in the era of 2D-diagnostic angiography.[5] The small aneurysm detection rate increased from 57.6% to 75.6% after 3D-diagnostic angiography.

Nowadays, there is only SAH study which was described in our region but the other neurovascular diseases had not been studied yet. In this study, we sought to elucidate current frequency of indication for diagnostic angiogram and trends of the neurovascular diseases in the northeastern of Thailand by angiographic base.

Materials and methods

Patients and Target Populations

This descriptive retrospective study included the patients who underwent the first diagnostic cerebral or spinal angiography, listed in the database of interventional neuroradiology unit between January, 2014 and December, 2016. Follow-up cerebral or spinal angiogram was excluded. There were 739 patients for target populations.

Image Acquisitions and Techniques

The diagnostic cerebral angiogram was performed via transarterial femoral approach with 5-F sheath and diagnostic catheter under local or general anesthesia. Rotational angiographic images were obtained using Siemens Artis Zee Biplane. The 2D-DSA was conducted with a 1024 x 1024 matrix with a 25- 32 cm FOV and injection rate 4 ml/sec. Approximate 8 and 13 ml. of the iodinated contrast (Hexabrix) were injected for the internal carotid and vertebral angiograms, respectively. X-ray exposures were obtained at 4 frames/sec in arterial phase (4 seconds), 2 frames/sec in capillary phase (5 seconds) and 1 frame/sec in venous phase. 3D-DSA was carried out on biplane system with an 5-second 200 degree rotational run, with acquisition of 133 images, injection rate about 2.5 ml/sec and total volume 16 ml. in each internal carotid or vertebral artery.

For spinal angiogram, the single plane DSA was conducted with a 1,024 x 1,024 matrix with a 32-42 cm. FOV and injection rate 1 ml/sec. Approximate 9 ml. of the iodinated contrast (Hexabrix) were injected segmental angiograms. X-ray exposures were obtained at 1 frame/sec. 3D-DSA was carried out on biplane system with an 5-second 200 degree rotational run, with acquisition of 133 images, injection rate about 1.5 ml/sec and total volume 9 ml. in the interesting segmental artery.

Imaging Interpretation

The final diagnosis from diagnostic cerebral and

spinal angiograms in all target populations was reviewed, based on report in the database. These reports were documented by interventional neuroradiology team, including a 5 years' experience interventional neuroradiologist and two of 1 year's experience interventional neuroradiologists.

Data and Disease Classifications

The data records of all 739 patients who underwent diagnostic cerebral or spinal angiography were reviewed. The demographic data; age and sex were collected. Indications for diagnostic angiogram were reviewed and angiographic based diagnosis was classified into 9 groups.

Statistical analysis

The demographic data were analyzed and presented as mean, frequency and percentage. Indications for angiography and angiographic characterization of diseases were demonstrated with tables of frequency and percentage. We also described trend of diseases in 3 years, 2014-2016.

Ethical Considerations

This study did not reveal the patients' name or hospital ID by recording and sorting patients with research ID. During the imaging was reviewed, patients' name and hospital number were concealed. This research was submitted to the institutional review board for ethical consideration. (HE611022)

Results

Demographics Data

There were 739 (373 males) with mean age of 46.33 years, mode age of 48 years and median age of 49 years patients who underwent diagnostic angiography in our INR unit between January, 2014 to December, 2016. Maximum and minimum age is 92 years and 2 years, respectively.

Indication for Diagnostic Angiography

The most frequent indication for diagnostic angiography was intracranial hemorrhage, accounting for 58.05% of population, 429 patients. SAH is the most common presentation of intracranial hemorrhage presentation (36.54%), followed by multi-compartment hemorrhage (10.15%), IPH (7.04%) and IVH (4.33%).

The second most common indication for diagnostic cerebral angiography was non-intracranial symptoms, accounting for 35.86% of total population (265 patients). The most common presentation of this group was eye symptoms (13.40%), followed by head and neck mass (7.85%), seizure (5.82%), neurological deficits (5.14%), headache (2.57%) and tinnitus (1.08%).

The third most common indication was extracranial hemorrhagic presentation, 15 patients (2.03%). There are 8 patients with epistaxis (1.08%) and another 7 patients (0.95%) were presented with bleeding tumors of the head and neck.

The spinal cord symptoms were accounted in 11 patients (1.49%). Most frequent spinal symptom was cord congestion, accounting for 8 patients (1.08%). And 1 patient was presented with spinal hemorrhagic presentation (0.14%). There were 2 patients with spine/spinal cord mass.

In our survey, there were 8 patients (1.08%) with asymptomatic presentation. 7 patients of this group were suspected aneurysmal lesion from follow-up MRI. 1 patient was suspected BAVM from MRI brain without clinical symptom. Diagnostic cerebral angiograms were requested for confirmed diagnosis. (Table 1)

Disease Classification

The most common disease diagnosis was intracranial aneurysm for 278 patients (37.61%). The second most common diagnosis was intracranial neurovascular malformation, 130 patients (17.59%) followed by traumatic associated neurovascular diseases 83 patients (11.23%), intracranial dural arteriovenous fistula in 59 patients (7.98%), head-neck tumor and vascular malformations in 56 patients (7.58%), ischemic and steno-occlusive disease in 29 patients (3.92%). Spinal vascular diseases were diagnosed in 12 patients (1.62%) and 1 pediatric neurovascular disease (0.14%), VGAM was diagnosed in 2016.

Intracranial aneurysm

From 278 cases who were diagnosed with intracranial aneurysm, there were 246 (88.47%) patients having single aneurysm and 32 patients (11.51%) had multiple aneurysms. We found 323 aneurysms in our study. The most of intracranial aneurysms was presented with rupture, 280 aneurysms (87%). Non- ruptured aneurysm were 43

Table 1 Indications for Diagnostic Angiography

	Total N (%)
Intracranial Hemorrhagic presentations	429 (58.05)
IPH	52 (7.04)
SAH	270 (36.54)
IVH	32 (4.33)
Multicompartment	75 (10.15)
Extracranial Hemorrhagic presentations	15 (2.03)
Massive epistaxis	8 (1.08)
Bleeding tumor	7 (0.95)
Non-Hemorrhagic presentations	265 (35.86)
Neurological deficits	38 (5.14)
Seizure	43 (5.82)
Headache	19 (2.57)
Head & Neck mass	58 (7.85)
Eye Symptoms	99 (13.40)
Tinnitus	8 (1.08)
Spinal Symptom	11 (1.49)
Spinal hemorrhagic presentation	1 (0.14)
Cord congestion	8 (1.08)
Spine/Spinal cord mass	2 (0.27)
Asymptomatic (incidental finding without clinical symptom)	8 (1.08)
Total	**739 (100)**

aneurysms (13%). Overall 323 aneurysms, 190 of them (58.82%) were found in the anterior circulation and 133 aneurysms (41.18%) were found in posterior circulations. The most common locations of intracranial aneurysm was ACA/ACoA complex region, 98 aneurysms (30.34%) and the second most common was at PCoA junction, 71 aneurysms (21.98%). We collected the aneurysm size by measurement in 3D-DSA. Most cerebral aneurysms were small size (< 7mm), 216 aneurysms (68%).

Intracranial neurovascular malformation

Most intracranial neurovascular malformation was sporadic AVM. We found 128 sporadic AVMs, 1 proliferative angiopathy and 1 developmental venous anomaly. There were 89 patients (69.53%) with ruptured brain AVM and 39 patients (30.47%) with non-ruptured brain AVM. Most of BAVMs were supratentorial region in 113 patients (88.28%), infratentorial BAVM 15 patients (11.72%). Location of BAVM, most common was subcortical, corticoventricular in location 81 patients (63.28%), followed by cortical BAVM 17 patients (13.28%), deep seated BAVM 15 patients (11.72%) and special location (choroidal and corpus callosal AVM) in 15 patients (11.72%). Small size (less than 3cm) brain AVM were common, 76 patients (59%) followed by moderate size (3-6 cm) BAVM, 49 patients (38%) and large BAVM (more than 6 cm) 3 patients (2%), respectively.

Intracranial dural arteriovenous shunts

There were 59 patients with intracranial dural arteriovenous shunt. 35 patients (59.32%) with of DAVS are aggressive, 24 patients (40.67%) were benign. In our study, the most common locations of shunt was CS, accounting in 31 patients (52.54%), followed by TSS in 14 patients (23.72%).

Traumatic neurovascular diseases

Most common traumatic associated neurovascular disease was extracranial disease, 14 patients (16.87%). Intracranial diseases were found in 69 patients (13.13%). The most common angiographic presentation was TCCF, 58 patients (71%). Second most common was pseudoaneurysm/ traumatic pseudoaneurysm, 14 patients (17%), followed by traumatic non-CCF and traumatic dissection.

Head/Neck tumors and vascular malformations

The most common head and neck tumor was JNA (N= 17, 30.37%) with preoperative embolization indication. The second most common disease was head and neck AVM, accounting for 13 patients (23.21%).

Spinal vascular disease and spine/spinal cord tumor

For spinal vascular disease and spine/ spinal cord tumor, the most common disease was spinal dural AVF, accounting for 6 patients (50%) followed by spinal AVM/AVF in 4 patients (30%).

Ischemic stroke and steno-occlusive disease

The most common ischemic and steno-occlusive diseases were Moya Moya disease and atherosclerotic disease, accounting for 9 patients (31.03%) for each disease

Table 2 Distribution of disease classification in each year

	2014 N (%)	2015 N (%)	2016 N (%)	Total N (%)
Intracranial aneurysms	53 (27.45)	109 (57.07)	116 (39.73)	278 (37.61)
Intracranial neurovascular malformations	34 (17.80)	42 (21.99)	54 (18.49)	130 (17.59)
Intracranial DAVS	24 (12.57)	17 (8.90)	18 (6.16)	59 (7.98)
Traumatic neurovascular disease	27 (14.14)	24 (12.57)	32 (10.96)	83 (11.23)
Head/Neck Tumor and vascular malformations	20 (10.47)	17 (8.90)	19 (6.51)	56 (7.58)
Spinal vascular disease and Spine/Spinal cord tumor	4 (2.09)	2 (1.05)	6 (2.06)	12 (1.62)
Pediatric neurovascular disease	-	-	1 (0.34)	1 (0.14)
Ischemic stroke & steno-occlusive disease	7 (3.66)	8 (4.19)	14 (4.80)	29 (3.92)
Negative diagnostic angiogram	22 (11.52)	37 (19.37)	32 (10.96)	91 (11.31)
Total	191 (100)	256 (100)	292 (100)	739 (100)

Distribution of Disease Classification and Trend in Each Year

For 3 years period (2014 - 2016), overall number of diagnostic cerebral angiography in our institute was increased, per disease (Table 2). Trends of angiography for intracranial aneurysm and neurovascular malformation had increased markedly within 3 years. (Figure 1)

Discussion

Our study is the first study which provides demographic data, indication for diagnostic angiography, classification and trends of neurovascular disease in northeastern of Thailand.

Concerning about indications of diagnostic cerebral angiogram in our institute, intracranial hemorrhagic presentations is the most common (58.5%), especially SAH (36.5%), similar to Hussian et al (48.6%).6 We found that the second common indication from our study was eye symptom (13.40%), including proptosis, congestion, and ophthalmoplegia. These clinical symptoms are usually found in TCCF and cavernous DAVF which higher incidence in our

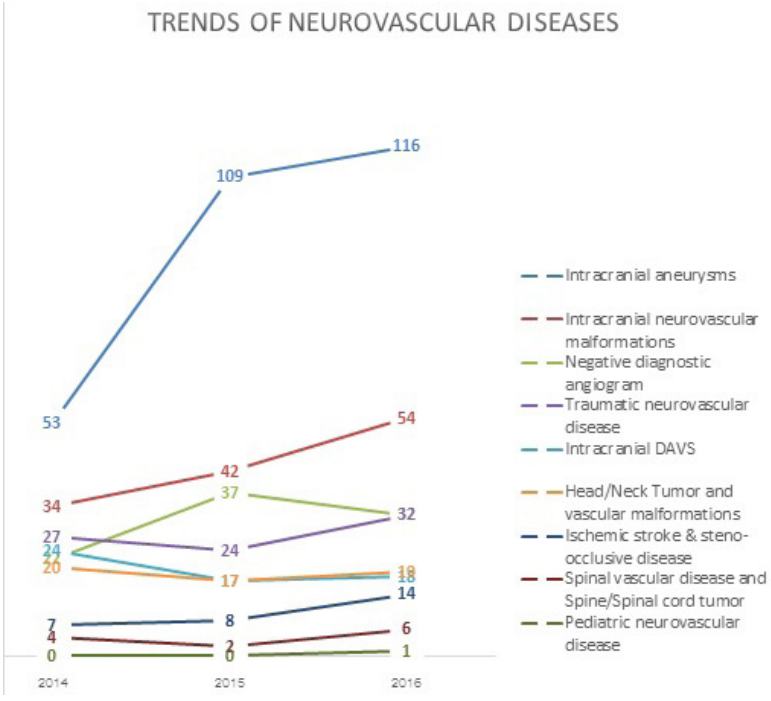

Figure 1 Linear graph of trends in each disease classification.

Trends of intracranial aneurysm and neurovascular malformation have increased markedly within 3 years.

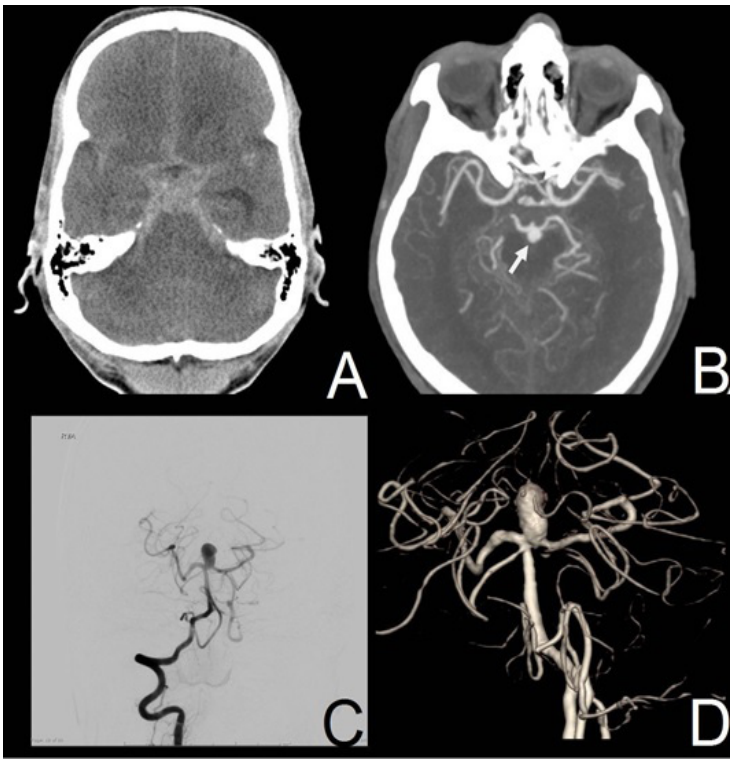

Figure 2 A 56 years old man presented with spontaneous SAH. A. NCCT brain revealed diffused SAH at suprasellar cistern. B. CTA demonstrated a small basilar tip aneurysm (arrow). C. Right vertebral angiogram showed basilar tip saccular aneurysm D. 3D-DSA with VRT reconstruction presented basilar tip aneurysm neck involving left proximal P1 PCA.

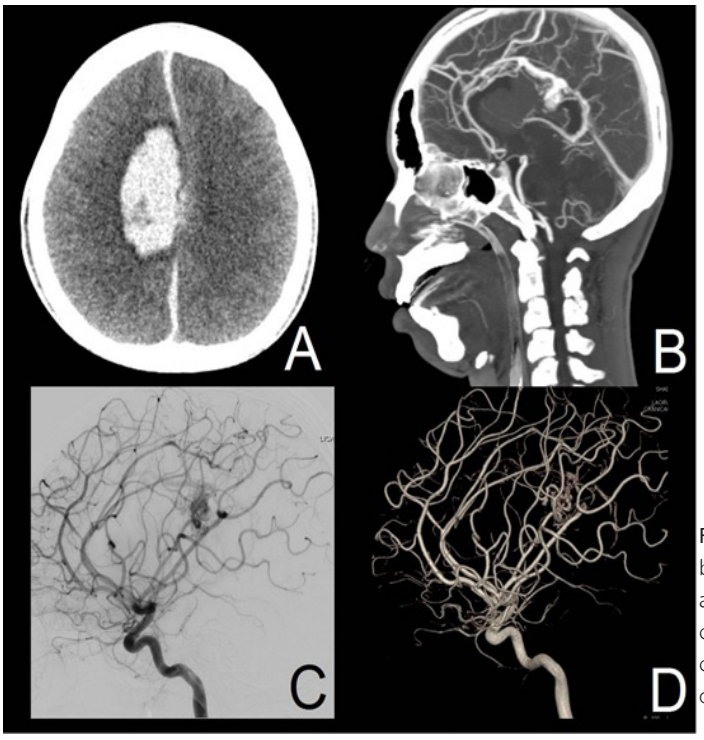

Figure 3 A 15 years old man presented with seizure. A. NCCT brain showed IPH at right parasagital frontal lobe and SDH along falx cerebri. B. MIP CTA brain depicted abnormal group of vessel at posterior corpus callosum. C, D. 2D and 3D DSA of RICA showed small size BAVM at right posterior corpus callosum.

region.

About the indication for diagnostic spinal angiogram, the most common indication is spinal cord congestion (72.7% of spinal symptom). According to regional study in Japan[8], the most common presentation of spinal vascular disease is non-hemorrhagic presentation. The most common disease diagnosis of spinal vascular disease and spine/spinal cord tumor is spinal dural AVF (50%), same as previous study[8]. Spines/ spinal cord tumor are documented about 20%.

From our study, five most common diagnoses by angiographic based were intracranial aneurysm (37.61%), intracranial neurovascular malformations (17.59%), negative diagnostic angiogram (11.31%), traumatic neurovascular disease (11.23%) and intracranial DAVFs (7.98%). In case of high incidence in negative diagnostic angiogram, nearly all of the

results were present with SAH. This result was compatible with our institute as a role of referral center which non-traumatic SAH with negative angiogram could be presented[5]. This result supports SAH as the most common epidemiological presentation despites with/without intracranial aneurysm.

Concerning about aneurysmal disease, ruptured aneurysm is the most common presentation in our institute (86.69%). (Figure 2) In contrast to Fifi et al study[9], most aneurysms, which performed diagnostic cerebral angiogram, were non-ruptured (58%). High incidence of non-ruptured aneurysm in this study could be due to awareness or there is guideline for screening diagnostic cerebral angiogram for intracranial aneurysm. Because of most diagnostic cerebral angiogram performed in symptomatic patients, this could be a cause of higher incidence of ruptured aneurysm in our study. For aneurysm location, themost common location of aneurysm is in anterior circulation. And most common size of aneurysm is small size, which is not different from previous studies in Western and Asia[10-12].

BAVM in our study shows high incidence of ruptured BAVM (69.53%), twice as non-ruptured BAVM (30.47%) (Figure 3). Because of most diagnostic cerebral angiogram performed in symptomatic patients with high incidence of intracranial hemorrhagic presentation, resulting in higher incidence of ruptured BAVM in our study, contrast to Stapf et al[13]. The most common characteristics of BAVM is supretentorial location (88.28%), located in eloquent area (54.69%), cortical/subcortical location (63.28%) and small size (59.38%), similar to Xianli et al[14].

Among the patient with traumatic neurovascular disease, It seems to be higher incidence in our study. These could be the result from current situation of road traffic injuries in Thailand which are still large numbers[15,16]. The most common traumatic neurovascular disease in our study was TCCF (70.73%). Because of essential management is endovascular treatment. For this reason, this may cause higher incidence of TCCF than other neurovascular disease. The fifth most common angiographic based diagnosis was DAVS. The true incidence of DAVFs is unknown. However, the previous reported incidence of intracranial DAVS is approximately 10-15%.[17] Because of present evidence suggests that DAVS are acquired lesions and present later in life than AVMs.[18] We considered to report the incidence of DAVS solely, about 7.9%. Concerning characteristics of DAVS in our study, most of DAVS are aggressive type (59.32%) and CS in location (52.54%) which is related to common indication as eye symptom. Previous series from western countries reported that the most common location of DAVS is TSS, followed by CS[19-21]. We found CS is the most frequent location of DAVS as in Asian population[22,23].

Trends of these five common diseases were increasing in three consecutive years. According to development of our institute as referral center of the Northeast, service capacity and quality of referral system were developing.

In our institute, head/neck tumor which is not common to performed diagnostic angiography are including JNA (30.37%), meningioma (16.07%) and paraganglioma (7.14%). In concerning with head/neck vascular malformation, we found head/neck AVM (23.21%), hemangioma/hemangiosarcoma (16.07%). And others tumor (osteosarcoma, Fibrosarcoma, CA gum, Mandibular metastasis) are accounting for 7.14%.

Incidence of pediatric neurovascular disease, ischemic and steno-occlusive disease are relatively low incidence in our institute. Because of current development of regional clinical practice guidelines and patient enrollment system, trends of these uncommon diseases are variable in our study.

Conclusion

Overall indication and trends neurovascular disease in northeastern of Thailand are variable among clinical presentation and disease classification. Incidence of the most common neurovascular diseases are aneurysm with ruptured (37.89%), AVM with ruptured (12.04%), TCCFs (7.98%) and DAVFs (7.98%). Epidemiology of spinal vascular disease and spine/spinal cord tumor, head/neck tumor and vascular malformations, pediatric neurovascular disease, ischemic and steno-occlusive disease cannot be implied due to low incidence. In our institute, trends of the common and uncommon diseases seem to be increased, related to development capacity our multidisciplinary teams and quality of regional referral systems.

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