The 39th Annual Meeting of the Japan Academy of Neurosonology
December 8-9, 2020

ABSTRACT

THE JAPAN ACADEMY OF NEUROSONOLOGY

第39回日本脳神経超音波学会総会
英文抄録集

2020年12月8日（火）～9日（水）
会長：矢坂 正弘（国立病院機構 九州医療センター）
Mobile plaque is thought to be "plaque to be noted" according to "standard evaluation of the carotid artery using ultrasound 2017" by The Japan Academy of Neurosonology and The Japan Society of Ultrasonics in Medicine. The most dangerous plaque we have to pay attention to could be embolic source of cerebral infarction. Mobile plaque could be classified into 3 variants. Floating plaque is defined as "a structure that adheres to the entire plaque or the surface of plaque moves (vibrates) due to blood flow" and can be detected with a sign so called B-Flow Winker (Winker sign). On the other hand, Jellyfish plaque is defined as "the entire plaque surface or part of the surface deforms with arterial pulsation". This plaque could suggest very fragile and one of the risk factors of thromboembolic brain infarction. However, Jellyfish plaque is technically difficult to detect mainly due to its movement similar to blood vessel pulsation. Here, we describe an efficient method for visualizing mobile plaque.

**Keywords:** Jellyfish plaque, Floating plaque, B-Flow Winker, Winker sign, Mobile plaque
The utility of transoral carotid ultrasonography for carotid artery lesion

Yuta Hagiwara
Department of Neurology, St. Marianna University School of Medicine, Japan

Transoral carotid ultrasonography (TOCU) is a useful tool for diagnosis of the extracranial internal carotid artery (ICA), which was first proposed by Yasaka (chairman of the 39th annual meeting of the JAN). TOCU is a powerful tool for evaluating ICA dissection, carotid stent, and aneurysm located from carotid bifurcation to the second cervical vertebra.

Contrast-enhanced transoral carotid ultrasonography (CETOUCU), which is essentially TOCU performed with the contrast agent, produces a clear intraluminal image of the extracranial ICA, which is not possible with conventional carotid artery ultrasonography.

Superb micro-vascular imaging (SMI) is a new Doppler imaging that uses a unique algorithm to minimize motion artifacts by eliminating clutter signals based on analysis of tissue movement. SMI reduces motion artifacts and allows visualization of low-velocity blood flow in vessels. TOCU with SMI also produces clear intraluminal image of the extracranial ICA without the contrast agent.

Based on our experience, image quality of TOCU with SMI could be comparable to CETOCU. In our presentation, we introduce the state of the art in TOCU.

Keywords: Transoral carotid ultrasonography (TOCU), Contrast-enhanced transoral carotid ultrasonography (CETOUCU), Superb micro-vascular imaging (SMI)

Symposium 2
Neurosonology required for CAS or CEA

S2-1
Carotid ultrasonography before the intervention of carotid stenosis

Toshiyasu Ogata1, Yoshio Tsuboi1, Hirofumi Shimada2
Department of Neurology, Fukuoka University1, Clinical Laboratory, Fukuoka University Hospital2, Japan

We usually evaluate carotid plaque with significant stenotic le-
S3-3
Clinical Significance of the Champagne Bottle Neck Sign in the Extracranial Carotid Arteries of Patients with Moyamoya Disease

Chiharu Yasuda
Steel Memorial Yawata Hospital, Japan

Background and Purpose: The champagne bottle neck sign (CBNS) represents a rapid reduction in the extracranial ICA diameters and is a characteristic feature of moyamoya disease (MMD). However, the clinical significance of the CBNS is unclear. We investigated the relationship between the CBNS and the clinical and hemodynamic stages of MMD.

Patients and Methods: Fourteen patients with MMD were evaluated before revascularization (5 men, 9 women; age, 43.2 ± 19.3 years). The ratio of the extracranial ICA and CCA diameters was determined using carotid ultrasonography or cerebral angiography; a ratio of <0.5 was considered CBNS-positive. The clinical disease stage was determined using Suzuki’s angiographic grading. CBF and CVR were also measured.

Results: The ICA/CCA ratio decreased as the clinical stage advanced. Symptomatic arteries tended to have a lower ICA/CCA ratio than asymptomatic ones. Although the ICA/CCA ratio was not related to cerebral perfusion, it decreased as CVR decreased (p<0.01). All CBNS-positive arteries were classified as Suzuki stage ≥3, 73% were symptomatic, and 89% exhibited reduced CVR.

Conclusion: The CBNS was related to advanced clinical stage, clinical symptoms, and impaired CVR. Thus, detection of the CBNS may be useful in determining the clinical and hemodynamic stages of MMD.

Keywords: moyamoya disease, champagne bottle neck sign, Suzuki’s angiographic grading

S3-4
Difference of underlying diseases between unilateral and bilateral champagne bottle neck sign

Masanori Tomoda
Department of Emergency and Critical Care Center, Saiseikai Fukuoka General Hospital, Japan

Background and purpose: We investigated whether background factors of patients with bilateral “Champagne bottle neck sign” (CBNS) are different from those with unilateral CBNS.

Methods: Subjects were 26 patients with CBNS demonstrated by carotid ultrasonography, who received brain MRT. The CBNS was noted unilaterally in 13 patients and bilaterally in the other 13. We compared between the two groups incidence of atherosclerotic risk factors, carotid plaque on ultrasonography, and brain MRA findings that were characteristic of moyamoya disease or atherosclerosis.

Results: Prevalence rates of hypertension, dyslipidemia, and plaque at the carotid arteries were higher in the unilateral group than in the bilateral group significantly (p=0.03). MRA findings of moyamoya disease was more frequently seen in the bilateral group than in the unilateral group (46% vs. 100%, p<0.01) and that of atherosclerotic disease was seen in 46% of the unilateral group but not in the bilateral group (p<0.01).

Conclusions: It seems that bilateral CBNS is strongly related to moyamoya disease and the unilateral CBNS is not only to moyamoya disease but also to atherosclerosis.

Keywords: Champagne bottle neck sign, moyamoya disease, atherosclerosis

Symposium 4
How to make a report after neurosonological evaluation

S4-1
To create carotid ultrasonography reports toward accurate diagnosis

Yoko Ito
Department of Clinical laboratory, National Hospital Organization Kyusyu Medical Center, Japan.

Carotid ultrasonography is a non-invasive study to evaluate cerebral vascular diseases. Actually, we are using carotid ultrasonography frequently for screening for cerebral vascular diseases. The role of carotid ultrasonography in our hospital is wide variety, such as embolus search in acute cerebral infarction, screening as diabetics complications, diagnosis of efficacy after stent implantation.

It is required to create a report that suits each purpose. We are often the first to discover life-threatening conditions, and we must organize what is important to tell our doctors and create a report that will lead to an accurate diagnosis. Of our hospital report, the measured value of the diameter and flow rate are listed in a tabular format. In the comments section, we mention a lot of things, such as plaque mobility and restenosis findings in the
stent. Photos can be pasted 4 sheets. Diagnosis is listed in order of importance.

What I keep in mind when writing reports is that describe it in an easy-to-understand manner, respond to the request purpose, clarify the places that have not been evaluated and evaluate according to the guidelines. If we discover an urgent condition, we need to contact your doctor immediately.

**Keywords:** report, diagnosis, carotid ultrasonography

---

**S4-3**

**Detection of micro embolus using ultrasound in the stroke medical care**

Hidetaka Mitsumura, Ayumi Arai*, Maki Tanabe, Takeo Sato, Teppei Komatsu, Kenichiro Sakai, Yasuyuki Iguchi
Department of Neurology, *Radiology, The Jikei University School of Medicine, Tokyo, Japan

Transcranial Doppler (TCD) and transcranial color flow imaging (TC-CFI) can detect highintensity transient signals (HITS) /microembolic signals (MES). The occurrence of HITS/MES suggest the presence of embolic source in carotid arteries, thoracic aorta, heart and so on, therefore, HITS/MES provide important information considering etiology of ischemic stroke.

Moreover, the evaluation of contrast MES using TCD/TC-CFI is useful for screening right -to-left shunt such as patent foramen ovale, atrial septal defect, pulmonary arterio-venous fistula easily and low-invasively.

On the other hand, the embolus detection by TCD/TC-CFI is difficult to say unfortunately that it is widely diffused because of insufficient temporal bone window in Japanese elder patients. We perform the enormous embolus detection positively using ultrasound for diagnosis of stroke. The important point for examination's report is intelligible description data based on the standardization of examination maneuver for diagnosis and therapy.

**Keywords:** TCD/TC-CFI, HITS/MES, right-to-left shunt

---

**S4-5**

**Neurosonology ultrasound report: Deep vein thrombosis**

Hirofumi Shimada1, Toshiyasu Ogata2
Department of Clinical Laboratory, Fukuoka University Hospital2, Japan

Ultrasonography of lower extremities is highly recommended for the identification of deep vein thrombosis and is considered as a good screening tool. There are two methods of ultrasonographic examination, whole leg ultrasonography (whole-leg US) and proximal compression ultrasonography (proximal CUS). Whole-leg US is to examine the entire lower extremities while observer examines the presence of DVT from thigh to popliteal fossa by compression in the proximal CUS. Because thrombi can exist in various places of lower extremities in the patients with paradoxical embolism, whole-leg US is recommended for the examination. The respiratory load and milking methods are not recommended. When a thrombus is detected, its echogenicity and the degree of vasodilation where the thrombus exists may help identify the time when the thrombus is made. The form of thrombus is classified into obstructive type, non-obstructive type, and free-floating type. Because floating type of thrombus as well as the finding of right ventricular overload by echocardiography may indicate the occurrence of acute pulmonary embolism, we should inform doctors. The presence of R-L shunt (patent foramen ovale, atrial septal defect, and shunt of pulmonary arteriovenous fistula) is needed on top of the existence of DVT for diagnosis of paradoxical embolism.

**Keywords:** DVT, whole-leg US, free-floating type

---

**S4-6**

**Report of neuromuscular ultrasonography findings**

Naoko Takamatsu, Hiroki Yamazaki, Yuishin Izumi
Department of Neurology, Tokushima University Hospital, Japan

Neuromuscular ultrasonography has three main categories: cervical nerve roots, peripheral nerves, and muscles. In the case of entrapment neuropathies such as carpal tunnel syndrome and cubital tunnel syndrome, the median nerve and ulnar nerve are examined independently. If polyneuropathy is suspected, observe the cervical nerve roots along with the peripheral nerves. The main observation items are swelling or atrophy of the nerve bundle size are also evaluated.

If muscle disease is suspected, the upper and lower limb observation sites should be evaluated regularly to assess the presence or absence of muscle atrophy and the muscle echogenicity in the widest possible range.
In the report, we describe the findings of the left and right upper and lower limbs, and make it easy to understand the presence or absence of laterality and the presence or absence of proximal or distal localization. In the case of amyotrophic lateral sclerosis, we report on all one page for findings of cervical nerve root and peripheral nerve cross-sectional area atrophy, systemic muscle atrophy, muscle echogenicity, and fasciculation.

**Keywords:** Neuromuscular Report, Cross-sectional

---

**Symposium 5**

**Current status and issues in evaluation of embolic sources**

---

**S5-2**

**Paroxysmal atrial fibrillation using insertable cardiac monitoring in cryptogenic stroke patients**

Ryosuke Doijiri¹, Naoto Kimura², Naoya Yamazaki¹, Momoyo Oda³, Ken Takahashi¹, Hideaki Endo¹, Michiko Yokosawa¹, Takayuki Sugawara³, Hiroaki Takahashi³, Takahiko Kikuchi¹

¹Department of Neurology, Iwate Prefectural Central Hospital, Morioka, Japan

²Department of Rehabilitation, Iwate Prefectural Central Hospital, Morioka, Japan

³Department of Neurosurgery, Iwate Prefectural Central Hospital, Morioka, Japan

⁴Department of Cardiology, Iwate Prefectural Central Hospital, Morioka, Japan

Insertable cardiac monitoring (ICM) is useful in the diagnosis of paroxysmal atrial fibrillation (PAF) in cryptogenic stroke (CS). The "Guide to the Diagnosis of CS as an Indication for ICM" published by the Japan Stroke Society recommends the use of transesophageal echocardiography and lower extremity venous echocardiography to exclude paradoxical cerebral embolism and aortogenic cerebral embolism, and neurosonology is recommended for the diagnosis of CS. We assessed the initial treatment outcome using insertable cardiac monitors in acute CS. We included 15 patients with CS who underwent insertable cardiac monitor placement at our hospital. The detection rate of AF at 12 months was 40%. We reported on another study. Of 102 consecutive acute ischemic stroke patients with large vessel occlusion treated by endovascular therapy, we included 10 with CS who underwent insertable cardiac monitor placement. The detection rate of AF at 12 months was 60%. The detection rate of AF in our hospital was higher than that in previous reports. We believe that the detection of PAF in ICM can be improved by appropriately performing neurosonology to narrow down the true CS. In this presentation, we will discuss the necessity of neurosonology in CS and the indications for ICM.

**Keywords:** insertable cardiac monitors, cryptogenic stroke, paroxysmal atrial fibrillation, large vessel occlusion

---

**S5-3**

**Evaluation for aortic arch plaques**

Yuji Ueno¹, Takao Urabe³, Nobutaka Hattori¹

¹Department of Neurology, Juntendo University School of Medicine, ³Department of Neurology, Juntendo University Urayasu Hospital, Japan

Aortic arch plaques are not uncommon and important embolic sources in cryptogenic stroke and embolic stroke of undetermined source (ESUS). Transesophageal echocardiography (TEE) is useful to detect aortic arch plaques, but is a semi-invasive modality, and limited stroke patients are conducted. Moreover, TEE is an aerosol- and droplet-producing examination, and indication of TEE should be carefully evaluated during COVID-19 pandemic. On the contrary, TEE contributed to clarify the pathogenesis of aortogenic embolic stroke. Aortic arch plaques were classified to Grade I-V. We previously demonstrated that aortic arch calcification, abnormal lipid profile, and multiple infarctions on MRI were associated with large aortic arch plaques in ESUS and cryptogenic stroke. Recently, we have conducted the CHALLENGE ESUS/CS, a multicenter observational registry of cryptogenic stroke patients who underwent transesophageal echocardiography. The CHALLENGE ESUS/CS registry explored that large aortic arch plaques were found in 38% of cryptogenic stroke, and were associated with high CHADS2 and CHA2DS2-VASc scores and cerebral microbleeds. As for treatment for aortogenic brain embolisms, we showed that 5mg of rosuvastatin stabilized aortic arch plaques. In the current lecture, we presented the current perspective for performance of TEE for stroke patients.

**Keywords:** aortic arch plaques, transesophageal echocardiography, cryptogenic stroke
**S5-4**

**Evaluation of deep vein thrombosis in patients with Cryptogenic stroke and patent foramen ovale**

Keiko Nagano  
Department of Stroke Neurology, National Hospital Organization Osaka National Hospital, Japan

Patent foramen ovale (PFO) may cause the paradoxical embolism and a risk of the ischemic stroke in young adults and cryptogenic strokes. But the frequency of PFO is approximately about 25% of the general population. Patients with PFO should be evaluated for presence of venous thromboembolism. Ultrasonography is essential for the diagnosis of deep vein thrombosis. We reported that the prevalence of ultrasonography detected venous thrombosis in patients with PFO was higher than usually reported for ultrasonography studies. The difference came from distal deep venous thrombosis discovered by exploring the calves. As another problem, diagnosis of DVT is difficult because of limitation in distinguishing acute from old thrombi, so, early ultrasonography is also useful for the diagnosis of DVT.

**Keywords:** deep vein thrombosis, patient foramen ovale, ESUS

**S5-5**

**Current issues and perspective of cancer-associated stroke**

Tomohisa Nezu¹, Naohisa Hosomi²,³, Hiroyuki Naito⁴, Shiro Aoki¹, Hirofumi Maruyama¹  
¹Department of Clinical Neuroscience and Therapeutics, Hiroshima University Graduate School of Biomedical and Health Sciences, Hiroshima, Japan  
²Department of Neurology, Chikamori Hospital, Kochi, Japan  
³Department of Disease Model, Research Institute of Radiation Biology and Medicine, Hiroshima University, Hiroshima, Japan  
⁴Department of Neurology, Hiroshima City Hiroshima Citizens Hospital, Hiroshima, Japan

Cancer-associated ischemic stroke refers to hyper-coagulation disorder related to malignant tumors or general arteriovenous thrombosis resulting therefrom. It is often called as Trousseau syndrome, but the definition is not unified. Increased D-dimer levels, infarcts in multiple vascular lesions, and elevated CA-125 levels might be associated with cancer-associated stroke. Cancer-associated venous thromboembolism (VTE) is also serious issue. Low-molecular-weight-heparins (LMWHs) have been established for the treatment of cancer-associated VTE. Several randomized controlled trials that have compared direct oral anticoagulants (DOACs) with LMWHs have recently been reported. DOACs might be more effective in preventing recurrent VTE compared to LMWH. However, several cases have been reported that a brain infarction occurred, although DOAC was useful for prevention of VTE. As it stands, there is a high possibility that heparin is suitable for cancer-associated stroke rather than DOAC. However, long-term subcutaneous heparin treatments cause to physical and mental issues. Novel treatments are expected for primary or secondary prevention of cancer-associated stroke.

**Keywords:** Cancer-associated stroke, direct oral anticoagulants

---

**Symposium 6**

**Up to date of neuromuscular ultrasonography**

Naoko Takamatsu, Hiroki Yamazaki, Yuishin Izumi  
Department of Neurology, Tokushima University Hospital, Japan

Muscle ultrasonography is useful in the diagnosis of many diseases such as myositis, muscular dystrophy, and muscular sarcoidosis. It is also an essential test in the diagnosis of amyotrophic lateral sclerosis (ALS).

This is because it allows for extensive observation of the fasciculation of the muscle.

At present, the diagnosis of neuromuscular diseases is mostly evaluated by needle electromyography and MRI. Recently myositis has been newly classified, and muscle ultrasonography plays an important role. For example, dermatomyositis shows fascial thickening and perifascial hyperechogenicity, and immune-mediated necrotizing myopathy and anti-ARS antibody myositis show hyperechogenicity. The characteristic findings of muscular ultrasonography are useful in diagnosing inclusion body myositis, such as divergence of echogenicity between the flexor digitorum profundus and the flexor carpalis ulnaris. In the future, it is desirable to combine morphological and functional examinations by making screening observations with muscular ultrasonography echography and then evaluating the necessary areas with needle electromyography and MRI. Echogenicity is a particularly important point in the evaluation, but it is difficult to perform quantitative analysis at present. Another issue that remains is that changes with aging are significant and difficult to assess.
Keywords: echogenicity, myositis, ALS

Topics 3
Advanced cross road between ultrasound and thromboembolism 1

TP3-2
Development and perspective of FXIa inhibitors (BAY1213790 and BAY2433334)

Juro Jinnouchi, Masahiro Yasaka, Kota Mori, Takahiro Kuwashiro, Yasushi Okada
Department of cerebrovascular medicine and neurology, Clinical research center, National Hospital Organization Kyushu Medical Center, Japan

FXIa inhibitor is newly developed anticoagulant that maintain the hemostatic function by inhibiting the intrinsic coagulation pathway (XII, XI, IX, VIII, X) without affecting the extrinsic coagulation pathway (tissue factor, VII, X). BAY1213790 (Osocimab) is a fully human monoclonal immunoglobulin G1 antibody that binds adjacent to the active site of FXI and reduces the activity of FXIa. Osocimab may be useful for patients with hepatic or renal dysfunction and reduce dosing frequency because of its characteristic. FOXTROT study revealed postoperative administration of Osocimab was non inferior to Enoxaparin and preoperative administration was superior to Enoxaparin in the prevention of venous thromboembolism among patients undergoing knee arthroplasty. In the field of cerebrovascular diseases, FXIa inhibitor is also expected to prevent cardioembolic stroke with atrial fibrillation. Currently a new FXIa inhibitor BAY2433334 is developed as a once daily oral drug. PACIFIC-AF study comparing the safety of BAY2433334 with apixaban was started in patients with atrial fibrillation. Anticoagulants have a trade-off relationship between anticoagulant activity and bleeding complications. However, FXIa inhibitor will be expected to reduce bleeding complications and exhibit strong anticoagulant activity, and may be the thread of Ariadne lead to escape the labyrinth in Greek mythology.

Keywords: FXIa inhibitor, BAY1213790, BAY2433334

TP3-3
Topics of sonothrombolysis

Hidetaka Mitsumura
Department of Neurology, The Jikei University School of Medicine, Tokyo, Japan

The possibility of facilitatory effect for thrombolytic agent by ultrasound has been shown in various kinds of fundamental experiment. This mechanism is considered that the cycle such as easy transfusion of thrombolytic agent (rt-PA) to a clot and excretion of degradation product is built due to the feeble effect of the last two things among four ultrasonic living body action (cavitation, thermal effect, micro vibration, micro flow).

In clinical study, the data from CLOTBUST study by Dr. Alexandrov in 2004 was first report of sonothrombolysis (using 2MHz) in the world. And then, Dr. Molina as their colleagues reported the effect of sonothrombolysis and microbubble in 2006.

On the other hand, TRUMBI trial using low frequency (300KHz) by Daffertshofer was stopped on the way because of intracranial hemorrhage with death. Dr. Furuhata (ME laboratory, The Jikei University) have solved the acoustic problems of TRUMBI trial and had plan to clinical study new ultrasound method (switching penetration of 500KHz and 2MHz), however, this study was not performed because of fewer applicable cases.

In CLOTBUST investigators group, they developed new specific microbubble for and novel probe for sonothrombolysis, however, neither reached positive results. This investigators group have ongoing trial for sonothrombolysis using operator independent ultrasound device.

Sonothrombolysis may be useful for target other than endovascular with advantage of ultrasound such as noninvasion and convenience.

Keywords: TCD/TC-CFI, sonothrombolysis, rt-PA
TP4-2
The new application and prospects of transoral ultrasonography

Yuta Hagiwara
Department of Neurology, St. Marianna University School of Medicine, Japan

Transoral carotid ultrasonography (TOCU) is a useful tool for diagnosis of the extracranial internal carotid artery (ICA), which was first proposed by Yasaka (chairman of the 39th annual meeting of the JAN). TOCU is a powerful tool for evaluating ICA dissection, carotid stent, and aneurysm located from carotid bifurcation to the second cervical vertebra.

We recently reported that we evaluated the involuntary movements of tongue in patient with palatal tremor and named this ultrasound technique as the “transoral motion-mode ultrasonography” (TOMU).

Transoral pharyngeal ultrasonography (TOPU) is a new ultrasound technique for otorhinolaryngology. TOPU is approached from TOCU, and useful for delineation of pharyngeal lesions. Peritonsillar abscesses is well known as common disease in otorhinolaryngology, and often needed a puncture drainage of abscesses. This procedure usually is performed blindly into the inside of pharynx, thus, it has a risk of fatal complications and low success rate. Therefore, TOPU-guided needle aspiration appears to be useful for safe drainage of peritonsillar abscesses.

In our presentation, we introduce the state of the art in transoral ultrasonography.

Keywords: Transoral carotid ultrasonography (TOCU), transoral motion-mode ultrasonography (TOMU), transoral pharyngeal ultrasonography (TOPU)

O1-1
Cervical artery pulse wave propagation related to intracranial hemodynamics and cardiac function

Toshiyuki Shiogai¹, Yuka Arima², Mari Koyama², Takashi Kasai³, Toshiki Mizuno³
Department of Clinical Neurosciences, Nara Central Hospital¹, Department of Clinical Laboratory, Kyoto Takeda Hospital², Department of Neurology, Kyoto Prefectural University of Medicine³, Japan

We have conducted wave intensity (WI) analysis in the common carotid and vertebral arteries (CCA and VA2), i.e., negative area (NA) and first peak (W1)/second peak (W2) as backward- and forward-traveling parameters reflected from the brain and heart, respectively. This study objected to compare cervical WI parameters with transcranial Doppler (TCD) and echocardiography.

Methods: In 10 healthy subjects and 10 cerebrovascular patients, NA, W1, W2, and calculated reflection coefficient (RC=NA/W1) were compared with TCD in the middle cerebral and intracranial vertebral/basilar arteries (MCA1 and VA4/BA), respectively, in terms of time-averaged maximum velocity (Vmax), pulsatility index (PI), and estimated cerebrovascular resistance (eCVR=mean BP/Vmax). In patients (n=7), left ventricular ejection fraction (EF), peak early diastolic filling velocity (E-wave)/peak arterial filling velocity (A-wave), and E-wave deceleration time (DT) were evaluated.

Results: Patients showed that 1) W1, W2, and NA were lower, RC was higher in the CCA, despite lower in the VA. W2 decreases were significant than W1/NA/RC decreases. 2)Vmax was lower and PI/eCVR was higher in the MCA1, V4, and BA. 3) normal EF, abnormal E/A (<1) and prolonged DT tendency (240ms>, n=4).

Conclusion: Cervical WI analysis is able to evaluate close relationship between intracranial and cardiac hemodynamics.

Keywords: cervical wave intensity analysis, intracranial hemodynamics, cardiac function
Correlation between middle cerebral artery pulsatility index and heart functions in ischemic stroke

Takeo Sato1, Akira Niijima2, Ayumi Arai3, Hiroki Takatsu1, Tepppei Komatsu1, Kenichi Sakata1, Kenichiro Sakai1, Hidetaka Mitsumura1, Yasuyuki Iguchi1
1Department of Neurology, the Jikei University School of Medicine, Tokyo, Japan, 2Department of Cardiology, the Jikei University School of Medicine, Tokyo, Japan, 3Department of Radiology, the Jikei University School of Medicine, Tokyo, Japan

Purpose: To determine transcranial Doppler ultrasonography (TCD) parameters related to unfavorable outcomes, and to clarify the correlations between those parameters and heart functions in acute ischemic stroke.

Methods: Patients were selected from a comprehensive stroke center between October 2012 and June 2019. Inclusion criteria were: 1) acute ischemic stroke without major vessel lesions; and 2) ability to measure blood flow in the middle cerebral artery by TCD. First, we investigated TCD parameters related to unfavorable outcomes (Cohort A). Second, correlations between those parameters and heart functions were evaluated (Cohort B).

Results: We screened 1,529 consecutive ischemic stroke patients, including 173 in Cohort A (146 [84%] male; median age, 59 years) and 192 in Cohort B (162 [84%] male; median age, 60 years). In Cohort A, pulsatility index (PI) (OR 0.054, 95%CI 0.006–0.516, p = 0.003) was independently associated with unfavorable outcomes. In Cohort B, age (OR 1.061, 95%CI 1.017–1.107, p = 0.006), leukoaraiosis (OR 2.107, 95%CI 1.400–3.172, p < 0.001) and E/e’ (OR 1.280, 95%CI 1.095–1.496, p = 0.002) were factors independently associated with high PI.

Conclusions: High PI predicts unfavorable outcome regardless of ischemic stroke subtype. High PI correlates with high E/e’, suggesting diastolic dysfunction.

Keywords: Brain ischemia; Heart failure; Transcranial Doppler sonography

Usefulness of left atrial strain by speckle tracking echocardiography in diagnosing stroke subtype

Akemi Yoshihara1, Hidehiro Takekawa1,2,3, Shigeru Toyoda4, Misaki Kawamata1, Natsuki Ejiri1, Naotoshi Takase1, Rika Shirasawa1, Sachio Konno1
1Center of Medical Ultrasounds, 2Stroke Center, 3Department of Neurology, 4Department of Cardiovascular Medicine, Dokkyo Medical University, Tochigi, Japan

Purpose: We investigated the usefulness of left atrial strain (LAS) in the diagnosis of cardioembolism (CE) caused by atrial fibrillation (AF), including paroxysmal AF.

Methods: Seventy-four consecutive ischemic stroke patients (mean age 69.7 years, 49 men) with LAS evaluated by transthoracic echocardiography (TTE) were included in the study. We classified the patients into CE group and other stroke group (non-CE group), and analyzed the differences in age, gender, risk factors, BNP, left atrial diameter (LAD), left atrial volume index (LAVI) and LAS using the chi-square test and Mann-Whitney U test. The area under the curve (AUC) was calculated by ROC curve.

Results: There were 13 patients in the CE group and 61 patients in the non-CE group. There was no difference in age or risk factors between the two groups. There was no difference in LAD and EF, however, CE group had higher LAVI and lower LAS: 35.8ml/m², 26.0ml/m², 20.3%, and 38.1%, respectively (p<0.05). The AUCs were 0.890, 0.793, and 0.892 for BNP, LAVI, and LAS, respectively, with LAS showing the highest utility.

Conclusion: LAS may be useful in the diagnosis of CE.

Keywords: Left atrial strain, speckle tracking echocardiography, atrial fibrillation

Analysis of left atrial appendage diameter and area in transesophageal echocardiographic study

Naoya Yamazaki1, Ryosuke Doijiri1, Momoyo Oda2, Ken Takahashi1, Hiroaki Takahashi1, Takahiko Kikuchi1
1Department of Neurology, Iwate central prefectural hospital,
Department of Rehabilitation, Iwate central prefectural hospital, Japan

**Background:** Transesophageal echocardiography (TEE) is a useful test for the diagnosis of cerebral infarction, and it has been reported that atrial fibrillation (AF) causes enlargement of the left atrial appendage (LAA) diameter and reduction of the LAA blood flow velocity.

**Method:** LAA diameter and LAA blood flow velocity were evaluated in 111 patients who underwent TEE for acute cerebral infarction in our department from January 2018 to December 2019. These parameters were compared between the sinus rhythm (SR) and AF groups.

**Result:** Of the 111 patients, 30 (27%) had AF, 16 (14%) persistent and 14 (13%) paroxysmal. AF group had significantly slower LAA inflow velocity, slower LAA outflow velocity, larger orifice, greater depth, and larger area, than the SR group. The sustained PAF group had a significantly slower LAA inflow velocity, slower LAA outflow velocity, larger orifice, and larger area, than the paroxysmal PAF group.

**Result:** The presence of AF was associated with LAA entry, depth, and area, more so in persistent AF. LAA enlargement on TEE in 2D may be associated with the presence of AF.

**Keyword:** transesophageal echocardiography, left atrial appendage, acute ischemic stroke

----

**O2-3**

A case of percutaneous left atrial appendage closure for cardiogenic embolism

Shuuichi Shimizu, Syota Fukushige, Mikiko Oohara, Ayako Tomita, Masaki Naganuma, Toshiro Yonehara, Youko Horibata, Tomohiro Sakamoto

Central inspection department, Cerebral neurology, Cardiovascular medicine, Saiseikai kumamoto hospital, Japan

**Background:** Cardiogenic embolism accounts for approximately 30% of cerebral infarctions, and its treatment and secondary prevention have consisted mostly of anticoagulant therapy. Implantation of a left atrial appendage closure device became covered by the Japanese Public Health Insurance last year, garnering attention as a new treatment for cardiogenic embolism. We report a case of cardiogenic embolism treated with percutaneous left atrial appendage closure.

**Case:** A 60-year-old woman was admitted to the emergency department with the chief complaint of an articulation disorder. T-PA was contraindicated due to her history of cerebral hemorrhage. She underwent tests to determine the cause. The disease type remained unidentified and she was transferred to another hospital for rehabilitation on the tenth day of illness. She became aware of palpitations at that hospital, was confirmed to have atrial fibrillation, and was referred to our hospital’s cardiovascular department for arrhythmia treatment. We determined that percutaneous left atrial appendage closure was indicated because of her history of hospitalization for cerebral infarction and her high risk associated with anticoagulant therapy due to her history of cerebral hemorrhage. The patient was admitted and underwent percutaneous left atrial appendage closure the next day.

**Conclusions:** The patient had an uneventful postoperative course without obvious thrombus formation, device instability, or residual jet in transesophageal echocardiography performed two months postoperatively. Percutaneous left atrial appendage closure has various indications and limitations, such as for postoperative oral drug use. This treatment, however, is considered to be a promising treatment/preventive option for cardiogenic embolism.

**Keyword:** Cadiogenic cerebral embolism, Left atrial appendage, Anticoagulation therapy

---

**O2-5**

Cerebral infarction due to papillary fibroelastoma in the left ventricle

Tomoko Adachi, Emi Hashimoto, Yoko Ito, Go Hashimoto, Kota Mori, Masahiro Yasaka

Department of Clinical laboratory, National Hospital Organization Kyusyu Medical Center, Japan

A 60 year-old man, he continued Tremor from early in the morning.

MRI showed sub-acute infarction in the right centrum semi-ovale.

Transthoracic echocardiography revealed a 6.5×5.8mm echogenic mass in the left ventricular outflow tract.

Diagnosis of cerebral embolism caused by cardiac tumor was jenerated and we performed tumor resection.

Pathological examination showed papillary hyperplasia of elastic fibers, which is a characteristic finding of papillary fibroelastoma (PFE).

Generally, PFE is a rare. Almost 80% of PFE is reported that located around the cardiac valves. However PFE localized in LVOT was rare case, as this case.

**Keyword:** papillary fibroelastoma, echocardiography
O2-6
A case of suspected embolization source of TIA caused by transcatheter aortic valve thrombosis

Akinobu Miyazaki, Yuki Okamura, Rie Yamamoto, Izumi Miyazaki, Misato Harada, Emi Tokiyoshi, Ryoko Osako, Kazuko Koreeda, Katsuyuki Umehashi, Kayoko Nozaki, Hiroshi Furuno
Department of Clinical Laboratory, National Hospital Organization Kagoshima Medical Center, Japan

Introduction: 7 to 13% of patients have thrombosis in the Transcatheter Aortic Valve Implantation (TAVI) valve. Can be embolization source such as stroke. We report a case in which a TAVI valve thrombosis was suspected by transthoracic echocardiography and a TIA occurred, mainly on echocardiography findings.

Case presentation: An 87-year-old woman. Transthoracic echocardiography was performed at 3 months after TAVI. The aortic valve PFV was 2.9m/s and the mean gradient was 19.4mmHg, and couldn't detected a thrombosis. But opening restriction in the TAVI valve, and blood flow convergence / loss. CT showed a low absorption area in the annulus of the TAVI valve. Treatment with warfarin and heparin was started. Four days later, right paresis including the face, dysarthria, and right half-body sensory impairment appeared. Symptoms improved, but re-examination 6 hours later revealed a new infarct lesion in the left parietal lobe, and the patient was diagnosed with TIA due to a TAVI valve thrombosis.

Conclusion: In the case of TAVI valve thrombosis, the valve PFV and mean gradient by echocardiography often do not show extremely abnormal values, so it is important to opening restriction of the TAVI valve and blood flow convergence / loss.

Keywords: TAVI valve thrombosis, transient ischemic attack, embolization source

O3-3
A case of neurosarcoidosis for which nerve ultrasound aided the diagnosis

Hiroki Yamazaki1, Naoko Takamatsu1, Kasane Shima1, Koji Fukushima1, Tatsuya Fukumoto1, Takeshi Yoshida1,2, Yusuke Osaki1, Yuishin Izumi1

1Department of neurology, Tokushima University Hospital, 2Department of neurology, Chikamori Hospital, Japan

Background and purpose: It is often difficult to determine a nerve biopsy for a patient. We report a case nerve morphology evaluation by nerve ultrasound helped determine nerve biopsy.

Case: 71-year-old woman. Numbness and weakness occurred in both legs from 10 months ago and worsened. The cranial nerve system was normal. Tactile and vibration sense were severely reduced below both knees, and tibialis anterior and gastrocnemius strength were reduced to 4/4 grade on manual muscle tests. Blood tests were all negative for antinuclear antibodies, anti-SS-A / SS-B antibodies, MPO-ANCA / PR3-ANCA, M protein, and cryoglobulin. Nerve conduction study showed decreased tibial CMAPs and loss of sural SNAPs bilaterally. Nerve ultrasound was added for evaluating nerve morphology.

Result: There were diffuse swelling in both sural nerves, and vascular wall thickening was also observed in the small saphenous vein. These suggested inflammatory changes. Sural nerve biopsy revealed noncaseating epithelioid granulomas in the nervous tissue. Blood ACE levels were normal, but chest CT showed bilateral hilar lymphadenopathy, and fundus examination confirmed uveitis. After diagnosing neurosarcoidosis, steroid administration improved lower leg symptoms.

Conclusion: Morphological evaluation of the sural nerve by nerve ultrasound supported the decision of nerve biopsy and helped diagnosis of neurosarcoidosis.

Keywords: neurosarcoidosis, nerve ultrasound, nerve biopsy

O3-4
An ischemic stroke patient with leg schwannoma confusing with deep venous thrombosis

Muneaki Kikuno, Takayuki Kimura, Yoshihiko Okubo, Takuto Hideyama, Haruhisa Kato, Hiroo Terashi, Hitoshi Aizawa
Department of Neurology, Tokyo Medical University Hospital, Japan

A 71-year-old man with past medical history of gastric carcinoma and depression, allergy for contrast medium presented to our hospital with sudden right hemiparesis and dysarthria. On admission, he had mild right facial palsy and dysarthria. And his initial NHSS score was 2. Brain MRI revealed high intensity signal in left posterior limb of internal capsule. Dual antplatelet therapy with aspirin and clopidogrel was started for treatment of acute minor ischemic stroke. On the 5th day of admission, lower extremity venous ultrasonographic evaluation elucidated the low
to isoechoic venous thrombosis in left soleal vein with major diameter of 30 mm. Since the 7th day, anticoagulant therapy with apixaban had been initiated instead of dual antiplatelet therapy. On 10th day, the patient was discharged independently without any hemorrhagic complication or thromboembolism. After 3 months, the follow-up ultrasonographic evaluation showed no reduction of venous thrombosis of left soleal vein, and we finally found that the structure was tibial nerve schwannoma confusing with venous thrombosis. Eventually, the secondary prevention was altered into aspirin again. In acute ischemic stroke case, the accurate ultrasonographic diagnosis of leg schwannoma is occasionally significant since it can become misleading differential diagnosis of venous thrombosis.

**Keywords:** lower extremity venous ultrasonography, leg schwannoma, deep venous thrombosis

---

**Oral Presentations 4**

**Dissection and temporal arteritis**

### O4-1

**Utility of carotid artery ultrasonography in the emergency room for diagnosing common carotid artery dissection**

Junichi Uemura, Sinji Yamashita, Masahiro Ohta, Yoshiki Yagita, Takeshi Inoue

1Department of Stroke Medicine, Kawasaki Medical School, General Medical Center, Japan 2Department of Stroke Medicine, Kawasaki Medical School, Japan

A 71-year-old woman was admitted to our hospital with sudden onset of right eye, disturbances in consciousness, and left hemiparesis. Brain magnetic resonance imaging revealed acute infarction in the right middle cerebral artery. Further, the signals of the right internal carotid artery, anterior cerebral artery, and middle cerebral artery were faint on magnetic resonance angiography. B-mode duplex ultrasonography in the emergency room showed iso- and hyper-echoic lesion in the right common-internal cervical artery. Contrast-enhanced computed tomography revealed right common artery occlusion. Therefore, we diagnosed right common carotid artery dissection. Superb microvascular imaging (SMI) of the carotid artery after one-week and two-week onset showed slow blood flow in the true lumen in the right common carotid artery. The findings of this case suggest that carotid ultrasonography in the emergency room is a useful modality for the diagnosis of common carotid artery dissection.

**Keywords:** carotid artery ultrasonography, common carotid artery dissection, superb micro-vascular imaging

---

**Oral Presentations 5**

**Venous thromboembolism**

### O5-1

**Evaluation of characteristics and contributing factors of recurrent venous thrombus via echo luminance analysis**

Hiromasa Tsubouchi, Osamu Yamamura, Yoshiyuki Miyashita, Yoshitaka Makino, Hiroyuki Satomi, Ikuko Kusui, Hiroshi Yatsushiro, Kouji Maeno, Masashi Yamashiro, Shiro Miyayama

1Department of Radiotechnology, Fukui-ken Saiseikai Hospital, Fukui, Japan 2Department of Community Medicine, Faculty of Medical Science, University of Fukui, Fukui, Japan 3Fukui-ken Saiseikai Hospital, Fukui, Japan

**Purpose:** In this study, we investigated the factors contributing to Recurrent venous thrombus (RVT) and the possibility of quantitative evaluation of lower extremity venous ultrasonography (LUS) via luminance analysis.

**Subjects and Methods:** In this study, 26 patients underwent LUS at our hospital between March 2016 and November 2019 and were diagnosed with RVT, and 95 patients in the control group underwent LUS between January and February 2019 and had no venous thrombus. Echo luminance was measured using ImageJ. The ratio of high-brightness to low-brightness areas was defined as the thrombus luminance ratio.

**Results:** The RVT group showed significantly more females (80.8% vs. 50.5%, p < 0.01), venous dilatation of 8 mm or more (46.2% vs. 8.4%, p < 0.01), and spontaneous echo contrast (SEC) (19.2% vs. 5.3%, p < 0.05) than the thrombus-negative group. Examination of luminance measurements showed a significant difference among the high luminance thrombus group, low luminance thrombus group, and normal vein group (161.6 vs. 43.3 vs. 3.0, p < 0.01). The thrombus luminance ratio of the RVT was 4.8±2.8.

**Conclusion:** Factors contributing to RVT were significant in women, venous dilatation of 8 mm or more, and patients with previous SEC. The thrombus luminance ratio may be useful in the diagnosis of RVT.
Keywords: recurrent venous thrombus, echo luminance analysis, contributing factor

O5-2
Study of DVT onset factors in patients with acute cerebral infarction and cerebral hemorrhage

Emi Hashimoto, Yoko Ito, Tomoko Adachi, Masahiro Yasaka
Department of Clinical laboratory, National Hospital Organization Kyusyu Medical Center, Japan

Purpose: The aim of this study was to elucidate the incidence of DVT and characteristics of the patient with acute cerebral infarction and acute cerebral hemorrhage.

Method: We retrospectively analyzed 254 patients (acute cerebral hemorrhage group) and 25 patients (acute cerebral infarction group), who went lower extremity venous echography study from January 2016 to December 2018.

Results: DVT was higher in acute cerebral hemorrhage group than acute cerebral infarction group (52% and 21% p<0.001). In the acute cerebral hemorrhage group, the number of days to lower extremity venous echography was longer in patients with thrombi than in patients without thrombi (14.0±7.7 days vs 8.9±5.9 days). In the acute cerebral infarction group, patients who could walk had significantly lower incidence of DVT than those who were in wheelchair or resting on the bed.

Conclusion: In this study, patients with acute cerebral hemorrhage had a significantly higher rate of DVT than patients with acute cerebral infarction. It was found the longer hospital stay, the higher risk of DVT in the cerebral hemorrhage group.

Keywords: Deep vein thrombosis, cerebral infarction, cerebral hemorrhage

O5-5
Evaluation of soleal vein diameter in patients with hypoechoic deep vein thrombosis

Naotoshi Takase1, Hidehiro Takekawa1,2,3, Shigeru Toyoda1, Misaki Kawamata1, Natsuki Eiji1, Akemi Yoshihara1, Rika Shirasawa1, Sachio Konno1
1Center of Medical Ultrasonics, 2Stroke Center, 3Department of Neurology, 4Department of Cardiovascular Medicine, Dokkyo Medical University, Tochigi, Japan

Purpose: Deep vein thrombosis (DVT) results in vein diameter dilatation. We evaluated bilateral difference cut-off in soleus vein diameter for predicting DVT, evaluated by lower limb venous ultrasonography.

Methods: Consecutive 42 subjects with unilateral soleal vein (SV) hypoechoic thrombosis in the central branch, detected by lower limb venous ultrasonography (DVT group) and 622 subjects without DVT (normal group) were included. Regarding statistical analysis, chi-square test and Mann-Whitney U test were used for two-group comparison and ROC curve was utilized.

Results: Bilateral difference of SV diameter were 1.7mm in DVT group and 0.7mm in normal group (p<0.001). For DVT diagnosis, the area under the ROC curve of bilateral difference was 0.708. When a cut-off value was set at 1.0mm, for DVT diagnosis, sensitivity was 73.8%, specificity was 64.8%, positive predictive value was 12.4% and accuracy value was 65.4%, but negative predictive value was high at 91.3%.

Conclusion: Hypoechoic DVT causes soleal vein dilatation by lower extremity venous ultrasonography, and hypoechoic DVT is unlikely when ultrasound examination shows bilateral difference of ≤1.0mm. However, if the bilateral difference was more than 1.0mm, it was necessary to perform a careful examination.

Keywords: Deep vein diameter, Bilateral difference, Lower extremity

O5-7
Two cases of deep vein thrombosis of the lower extremities for which lower extremity venous ultrasonography with Superb Micro vascular Imaging (SMI) was successful

Motoki Miyauchi1, Yuta Hagiwara2, Takahiro Shimizu2, Hiroyuki Onotogi1, Takanori Okamura1, Masaki Sakurai1, Masaki Izumo1, Yasuhiro Hasegawa2
1Ultrasound Examination Center, St. Marianna University School of Medicine Hospital kanagawa Japan, 2Department of Neurology, St. Marianna University School of Medicine, Kanagawa, Japan, 3Department of cardiology St. Marianna University School of Medicine, Kanagawa, Japan

The first case was a 69-year-old woman. In October X-17, she visited our hospital with a chief complaint of dysarthria and left hemiplegia. Two days after admission, an increase in D-dimer was found, and lower limb venous ultrasonography was performed for the cause of its high value. A suspected thrombus in the left fibular vein was found, and as a result of evaluation using SMI, the thrombus was clearly visualized by increasing the echo
contrast between the thrombus and the blood flow around the thrombus.

The second case was a 52-year-old woman in April X-19. her D-dimer level of her blood was found to be 21.6 μg/ml. Lower limb ultrasound was performed. The lumen of her left femoral vein was clearly dilated, deep vein thrombosis was considered. SMI visualized the spot as low in brightness, and no blood flow was observed. The diagnosis was made as the deep vein thrombosis. Its diagnosis was reconfirmed with the compression method as well.

SMI is a non-contrast technique making images by capturing the low blood flow. The compression method carries the risk of pulmonary embolism due to the procedure itself, however, the SMI could minimize the risk.

**Keywords:** SMI, DVT

**O5-8**

A case of inguinal hernia with venous thromboembolism revealed by lower limb and cardiac ultrasonography

Ryuta Okabe¹,², Ryosuke Komi¹, Naoyuki Katayama¹, Yoichi Matsunaga¹, Mitsuo Kashida², Hidehiro Takekawa²

¹Department of Cardiology, Akiru Municipal Medical Center, Tokyo, Japan
²Stroke center, Dokkyo Medical University, Tochigi, Japan

**Introduction:** We here report a case of bilateral inguinal hernia in whom vascular and cardiac ultrasound was useful in diagnosis of pulmonary embolism.

**Case:** A 80-generation female who has been medicated hypertension and diabetes mellitus for several years. She was suffering from gradually increasing hernia located at bilateral inguinal region. Her blood examination showed serum creatinine (1.2mg/dL) and D-dimer (1.71μg/mL) was slightly elevated. We took lower limb ultrasound and echocardiography apprehensive of deep vein thrombosis. Ultrasound findings showed hypoechoic thrombus located at right soleal vein, and increase tricuspid regurgitation compared to last year. Scintigraphy (99mTc) revealed pulmonary thromboembolism in left pulmonary artery. Immediately, her received anticoagulation therapy, after that, radical surgery for inguinal hernia was performed. Perioperative her circulatory dynamics affected by venous thromboembolism were good controlled with anticoagulation therapy.

**Conclusion:** We were able to detect pulmonary embolism from overloaded right heart findings, such as tricuspid regurgitation with pulmonary hypertension in echocardiography. Even slight elevation of D-dimer, we should be considered complications of venous thromboembolism in peripheral DVT patient.

**Keywords:** venous thromboembolism, lower limb ultrasonography, tricuspid regurgitation

**O5-9**

Diagnosis of Deep Vein Thrombosis with Ultrasonography in Iwate Prefectural Central Hospital

Takui Sonoda¹, Ryosuke Doijiri¹, Miki Abe⁵, Masanobu Miura³, Hiroshi Nashiki⁴, Ryoichi Sato¹, Naoto Kimura², Hideaki Endo³, Ken Takahashi¹

¹Department of Neurology at Iwate Prefectural Central Hospital, Japan
²Department of Neurosurgery at Iwate Prefectural Central Hospital, Japan
³Department of Cardiology at Iwate Prefectural Central Hospital, Japan
⁴Department of ICU at Iwate Prefectural Central Hospital, Japan
⁵Department of Clinical Laboratory at Iwate Prefectural Central Hospital, Japan

**Background:** In our hospital, ultrasonography was not performed routinely for DVT because of examination time and human factors, but in May 2019, it became possible to perform ultrasound of leg veins in the laboratory.

**Methods:** From May 2019 to April 2020, we examined patients who were suspected of having DVT and underwent ultrasonography of leg veins, performed by clinical laboratory technicians. The frequency and location of DVT, thrombotic properties, and presence or absence of pulmonary embolism were evaluated.

**Results:** During the target period, 151 patients (mean age: 72 years; 54 men) underwent ultrasonography for diagnosis and treatment of DVT in the departments of neurosurgery (65 patients [43%])]. The average D-dimer level before the test was 11.2 22.5 μg/mL, which was considered high. DVT was diagnosed in 79 patients (52%); 22 (27%) had femoral DVTs and 57 (72%) had lower leg DVTs. Pulmonary embolism developed in 19 (24%) of these 79 patients. The incidence of pulmonary embolism was higher among patients with femoral DVTs (13 [16%]) than among those with lower leg DVTs (6 [8%]; P < 0.001).

**Conclusion:** DVT was observed in 52% of patients who underwent lower extremity venous ultrasonography, and pulmonary embolism developed in 24%.

**Keywords:** deep vein thrombosis, lower extremity venous ultra-
**O6-1**
The association of ASC grading with discharge outcome in cryptogenic stroke: CHALLENGE ESUS/CS registry

Takahiro Shimizu, Yuji Ueno, Yohei Tateishi, Ryosuke Doijiri, Ayako Kuriki, Muneaki Kikuno, Hidehiro Takekawa, Masatoshi Koga, Takao Urabe

1Department of Neurology, St. Marianna University School of Medicine, Japan
2Department of Neurology, Juntendo University Faculty of Medicine, Japan
3Department of Neurology and Strokology, Nagasaki University Hospital, Japan
4Department of Neurology, Iwate Prefectural Central Hospital, Japan
5Department of Neurology, Showa University Koto Toyosu Hospital, Japan
6Department of Neurology, Tokyo Medical University, Japan
7Department of Neurology, Dokkyo Medical University, Japan
8Department of Cerebrovascular Medicine, National Cerebral and Cardiovascular Center, Japan
9Department of Neurology, Juntendo University Urayasu Hospital, Japan

**Background and Purpose:** The purpose of this research were to investigate the pathogenesis of cryptogenic stroke patients from the multicenter registry using the ASCOD classification and clarify the association of ASC with functional outcome at discharge.

**Methods:** CHALLENGE ESUS/CS is a multicenter registry and each patient was graded for the A, S, and C categories of the modified ASCOD system.

**Results:** A total of 672 patients (68.7 ± 12.8 years) were enrolled. In S and C factor, there were trends of higher frequency of critical grade in patients with poor functional outcome (P=0.014, P=0.010). Multivariate analysis with a Logistic model, female sex (odds ratio [OR]: 2.04, 95% confidence interval [CI]: 1.25-3.34), NIHSS (OR: 1.17, 95% CI: 1.12-1.22, P<0.001), CHADS2 score (OR: 1.49, 95% CI: 1.23-1.79, P=0.001), D-dimer (OR: 1.05, 95% CI: 1.01-1.09, P=0.019), both cortical and deep infarcts (OR: 2.34, 95% CI:1.13-4.84, P=0.022), and S + C score (OR: 1.28, 95% CI:1.02-1.60, P=0.031) were factors significantly related to poor functional outcome at discharge.

**Conclusions:** This research indicated ASC classification is useful to stratify the pathogenesis of cryptogenic stroke. A coexistence of small vessel diseases and cardiac pathology was related to inhospital poor functional outcome in cryptogenic stroke.

**Keywords:** cryptogenic stroke, ASCOD classification, Transesophageal echocardiography

---

**O6-3**
Clinical Features of Aortic Arch Plaques on Transesophageal Echocardiography

Shojiro Teruya, Kazuhito Kokuba, Hirokuni Sakima, Fumihiko Kinjo, Yoshitaka Yamada, Takayuki Yamashiro, Yukihiro Namihira, Satoshi Ishihara, Yusuke Ohya

Department of Cardiovascular Medicine, Nephrology and Neurology, University of the Ryukyus, Japan

**Background:** Atherosclerotic plaque in the aortic arch observed by transesophageal echocardiography (TEE) has clinical significance because it may cause cerebral embolism. There are few studies about echogenicity in the aortic arch.

**Method:** From January 2007 to February 2020, we underwent TEE to 135 patients. 113 patients had atherosclerotic plaque in the aortic arch. We divided patients into two groups; one is plaque built up only hyper echoic plaque, and the other is non-hyper echoic plaque. To decide echogenicity of plaque, we refer to guideline for carotid ultrasonography published by Japanese society of sonographers 2017. We used t-test and Wilcoxon rank sum test and chi-square test, to detect difference in two group.

**Result:** Average age was 67.2±11.9. 41 patients (36%) was woman. 62 patients had only hyper echoic plaque, 51 patients had non-hyper echoic plaque. Non-hyper echoic plaque was significantly associated with age (p=0.004), maximum thickness of plaque (p<0.001), formation of ulcer (p=0.002), development to aortic bifurcation (p=0.038), hypertension (p=0.026). On the other hand, there were no significant difference about sex, calcification of aortic arch watched by X-ray, smoke, diabetes, dyslipidemia.

**Conclusions:** Age and hypertension may be associated with a non-hyper echoic plaque in the aortic arch

**Keywords:** Transesophageal echocardiography, Atherosclerotic plaque in aortic arch, Cerebral emboli
O6-4
Difference of Transthoracic Echocardiography and Trans-esophageal Echocardiography Between Embolic Stroke of Undetermined Source and Cardioembolic Stroke

Hiroyuki Kida, Takeo Sato, Hiroki Takatsu, Teppei Komatsu, Kenichiro Sakai, Tadashi Umehara, Shusaku Omoto, Hidetomo Murakami, Hidetaka Mitsumura, Yasuyuki Iguchi
Department of Neurology, the Jikei University School of Medicine, Tokyo, Japan

Purpose: We compare transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) findings of embolic stroke of undetermined origin (ESUS) with cardioembolic stroke (CES) in Trial of Org 10172 in Acute Stroke Treatment classification.

Methods: Patients were selected from our hospital between April 2013 and September 2019. Inclusion criteria were: 1) consecutive ischemic stroke patients and 2) who underwent TTE and TEE. Then, we selected patients as follows: who were fulfilled ESUS criteria as ESUS, and who were non-ESUS and fulfilled CES criteria as cardioembolism (CE). We compared clinical features, including TTE and TEE parameters between both.

Results: We screened 1,529 consecutive ischemic stroke patients, including 191 patients (male 69%, median age 67 years old, ESUS; 118 patients [62%]). In logistic regression analysis, ejection fraction (EF) and left atrial dimension (LAD) were independently associated with ESUS (EF: OR 1.11, 95%CI 1.03-1.20, p = 0.006, LAD: OR 0.93, 95%CI 0.88-0.98, p =0.006) in TTE parameters. In TEE, spontaneous echo contrast (SEC) and right-to-left shunt (RLS) were independent factor with ESUS (SEC: OR 0.23, 95%CI 0.09-0.64, p = 0.005, RLS: OR 3.36, 95%CI 1.23-9.22, p =0.019) in TEE findings.

Conclusions: ESUS had better EF, smaller LAD, less SEC, and more RLS compared with CE.

Keywords: ESUS, TTE, TEE

O7-1
Technique to improve visibility of carotid intravascular ultrasound

Daisuke Izawa, Naotsugu Toki, Kazuhiro Nishiyama, Hiroyuki Matsumoto
Department of Neurological Surgery, Kishiwada Tokushukai Hospital, Japan

Purpose: In mechanical scanning IVUS catheters with high frequency (Hi-mIVUS), images of higher resolution can be obtained compared with electron scanning types. The aim of the present study was to investigate the technique to improve visibility of carotid intravascular ultrasound after carotid artery stenting.

Methods: Six cases of carotid artery stenting with proximal protection were included in this study. Saline negative contrast Hi-mIVUS with or without proximal occlusion was performed using the VISICUBE and AltaView of Terumo.

Results: Good visibility were achieved at saline negative contrast Hi-mIVUS with proximal protection in comparison to that without proximal protection. In large diameter carotid artery, visibility was more improved to remove blood speckle using saline negative contrast with proximal protection.

Conclusions: Saline negative contrast Hi-mIVUS with proximal protection may improve visibility of carotid intravascular ultrasound.

Keywords: carotid artery, IVUS

O7-2
Correlation among stenosis ratio, velocity, cerebral blood flow and ischemic size in patients with symptomatic carotid artery stenosis

Hirokazu Sadahiro, Kazutaka Sugimoto, Hideyuki Ishihara, Fumiaki Oka, Michiyasu Suzuki
Department of clinical neuroscience and neurosurgery, Yamaguchi University School of Medicine, Japan

Background: In patients with symptomatic carotid artery stenosis, watershed small ischemia is very common. On the other hand, some patients have large cortex ischemia. The purpose of this study is to identify correlation among stenosis ratio, velocity, cerebral blood flow and ischemic size.

Methods: From April 2009 to May 2019, we include the patients with symptomatic carotid artery stenosis in our hospital. The stenosis ratio and peak systolic velocity (PSV) were measured with ultrasound. Cerebrovascular reserve capacity (CVRC) was performed, and maximum ischemia size was measured with magnetic resonance imaging (MRI). We divide the patients into two groups; patients who have maximum ischemia size ≤15mm were group A, and maximum ischemia size >15mm were group...
B.

**Results:** We included 104 patients. There were no significant background difference between 2 groups. In group A, PSV was significantly high (391±172 cm/s vs. 298±126 cm/s, p<0.01) and CVRC was significantly low (15.5±25.7% vs. 24.9±19.6%, p<0.05). Multiple logistic analysis showed low PSV were independently associated with large ischemia.

**Conclusion:** This study demonstrated ulcer and low PSV were independently associated with large ischemia. PSV might reflect pathophysiology of embolic mechanism from carotid artery stenosis.

**Keywords:** Carotid artery disease, peak systolic velocity, cerebrovascular reserve capacity

O7-3

**Suitable methods of measuring acceleration time in the diagnosis of internal carotid artery stenosis**

Kentaro Iizuka,1,2 Hidehiro Takekawa,1,2,3 Akio Iwasaki,1,2,3 Haruki Igarashi1,2, Sato Kobayasi1,2, Daisuke Tsukui1,2 Keisuke Suzuki2

1Stroke Center, 2Department of Neurology, 3Center of Medical Ultrasonics, Dokkyo Medical University, Tochigi, Japan

**Purpose:** To clarify the optimal method of measuring acceleration time (AcT) for diagnosis of internal carotid artery origin (ICA) stenosis.

**Methods:** Ninety-three patients with ischemic stroke undergoing carotid ultrasonography and digital subtraction angiography (DSA) were enrolled.

AcT was determined by a conventional procedure (using the first peak point or the bending point) and the peak systolic velocity (PSV) procedure. The AcT ratio was calculated as (AcT of ICA)/(AcT of the ipsilateral common carotid artery). We evaluated the correlation of stenosis rate as assessed by the NASCET using DSA (DSA-NASCET) with the AcT of ICA (ICA-AcT), the AcT ratio measured by the conventional procedure (conventional AcT ratio), and the AcT ratio measured by the PSV procedure (PSV AcT ratio). The area under receiver operating characteristic curves (AUC) for DSA-NASCET was calculated based on the ICA-AcT and AcT ratio.

**Results:** DSA-NASCET was positively correlated with the conventional AcT ratio (r=0.723), conventional ICA-AcT (r=0.64), and PSV AcT ratio (r=0.25). The corresponding AUCs for ICA stenosis ≥50% were 0.97, 0.89, and 0.57, respectively.

**Conclusion:** We demonstrated the usefulness of the conventional procedure for diagnosing stenosis of ICA origin using AcT and showed that the AcT ratio was a more beneficial parameter than AcT.

**Keywords:** acceleration time, internal carotid artery stenosis, NASCET stenosis

O7-4

**Evaluation of common carotid artery and carotid bulb plaque in Tochigi prefecture citizens**

Akio Iwasaki,1,2 Haruki Igarashi,1,2 Ryuta Okabe,2,4 Ayano Suzuki,2, Keisuke Suzuki2, Hidehiro Takekawa1,2,3

1Stroke Center, 2Department of Neurology, 3Center of Medical Ultrasonics, Dokkyo Medical University, Tochigi, Japan, 4Department of Internal Medicine, Akiru Municipal Medical Center, Tokyo, Japan

**Purpose:** Carotid-intima media thickness (IMT) thickening is widely used for evaluating risk for vascular diseases.

**Methods:** Nine hundred and twenty-nine Tochigi prefecture residents were included in this study. Participants completed self-administered questionnaires including age, sex, vascular risk factors (smoking, alcohol use, hypertension, diabetes mellitus, dyslipidemia and sleep apnea), and a history of cardiac disease and stroke.

Carotid artery ultrasound was performed in a sitting position, and the maximum IMT (max-IMT) within the observable areas was measured. We investigated the risk factors associated with max-IMT ≥1.5mm.

**Results:** There were 248 cases without any risk factors for vascular disease. The median max-IMT of those cases was 1.0mm, with a significant positive correlation with age (r=0.55). After adjusting for age and sex, only hypertension was associated with max-IMT >1.5mm. On the other hand, in a multivariate analysis of 310 patients with hypertension, only smoking was associated with max-IMT ≥1.5mm.

**Conclusion:** Our previous study showed hypertension and smoking were related to max-IMT ≥1.5mm. In particular, smokers with hypertension in Tochigi prefecture should be careful about IMT thickening.

**Keywords:** maximum intima-media thickness, hypertension, smoking
O7-5
A case of external jugular venous aneurysm after minor trauma

Manami Mori1, Hiroyuki Ayukawa1, Sachiko Yamada1, Katsuhiro Yoshikawa2
1Department of Clinical Laboratory, Shiga General Hospital, Shiga, Japan
2Department of Plastic surgery, Shiga General Hospital, Shiga, Japan

Case: A woman in her 40s bruised her left supraclavicular fossa a month ago and noticed swelling. Cervical ultrasonography revealed a mass communicated with the left external jugular vein. The mass increased in the Valsalva maneuver and supine position, and blood flow from the external jugular vein was observed. Vascular malformation or venous aneurysm was suspected, and surgery was planned. Surgical findings showed 2 external jugular veins on the left, and a venous aneurysm was present at the confluence. Pathological findings showed that the mass was a cystic lesion, lined with endothelial cells, and had an organized thrombus inside. It was consistent with a venous aneurysm.

Discussion and Conclusion: Dilated lesions of veins are often classified into varix, venous aneurysm, and phlebectasia. This case was dilated like an aneurysm and was considered to be venous aneurysm. In this case, the cause of aneurysm might be minor trauma. Although there are many differential diseases that cause a cervical swelling, this case could be diagnosed by direct confirmation of increasing mass and its communication with the external jugular vein by ultrasonography. Cervical ultrasonography with the Valsalva maneuver was useful for the diagnosis.

Keywords: venous aneurysm, external jugular vein, ultrasonography

O7-6
Two cases of dissecting internal carotid artery aneurysm with long-term follow-up by transoral carotid ultrasound.

Takeshi Iwanaga1,2, Hiroshi Okada1, Yoshiki Yagita2
1Department of Stroke Medicine, Okayama Red Cross Hospital, Okayama, Japan
2Department of Stroke Medicine, Kawasaki Medical School, Japan

Case1. A 40-year-old man came to our hospital because he had transient blind of the left eye and right lower limb weakness. He had been a pain in the left neck seven days ago. He had no neurological sign on admission. Brain MRI showed multiple infarctions in the left middle cerebral artery territory (MCA) and left internal carotid artery (ICA) occluded. Carotid sonography revealed left ICA dissected occlusion. The second day he demonstrated aphasia and a new lesion on left MCA territory. Transoral carotid ultrasound illustrated recanalization of the vessel and dissection in the ICA. We undergo carotid artery stenting on the 18th day because peak systolic velocity raised from 170 to 450cm/s on the 5th and 11th day. Since then, we followed using transoral carotid ultrasound for four years without showing intrastent thrombus or enlargement of dissection.

Case2. A 70-year-old man has been referred by cardiovascular surgery because of carotid stenosis. Carotid sonography showed 80% ICA stenosis. Angiography illustrated dissecting aneurysm distal to the stenosis. Transoral carotid ultrasound demonstrated a 2cm aneurysm in the ICA. Cerebral blood flow did not decrease in scintigraphy, so revascularization was not performed. During the four years, systolic blood flow velocity increased to 340cm/s, but the aneurysm size did not change, and no ischemic event occurred.

Transoral carotid ultrasound can evaluate high-level internal carotid arteries, difficult to assess by carotid echography. It was useful for treatment decisions and follow-up in these cases.

Keywords: transoral carotid ultrasound, dissecting aneurysm, follow up a long period

Oral Presentations 8

CEA

O8-2
LCP distribution using NIRS is consistent with pathological evaluation in carotid artery plaque

Ichiro Nakagawa, Masashi Kotsugi, HunSoo Park, Shohei Yokoyama, Shuichi Yamada, Fumihiko Nishimura, Yasushi Motoyama, Young-Soo Park, Hiroyuki Nakase
Department of Neurosurgery, Nara Medical University, Nara, Japan

Purpose: We evaluated the consistency between the lipid core burden index (LCBI) measured by Near-infrared spectroscopy (NIRS) and histopathological diagnoses using carotid plaque.

Methods: Eleven patients with cervical carotid artery stenosis who underwent carotid endarterectomy were examined in this prospective study. Pathological diagnosis was determined after NIRS evaluation, which was performed on the extracted plaques...
in vitro. The histological slices of decalcified and paraffin-embedded sections were stained by hematoxylin-eosin (HE) and Elastica van Gieson (EVG), and for low-density lipoprotein (LDL), C-reactive protein (CRP), CD68, and glycophorin

**Results:** A. The correlation between LCBI values and histological findings. 11 patients had a vessel assessed by NIRS, resulting in 70 lesions being analyzed. There was a positive linear correlation between LCBI values and pathological findings as determined by HE, EVG, CRP, and CD68 staining (respectively, $r = 0.624, p < 0.001; r = 0.578, p < 0.001; r = 0.534, p < 0.001; r = 0.723, p < 0.001; r = 0.653, p < 0.001$).

**Conclusions:** The LCBI values assessed by NIRS showed a significant positive linear correlation with pathological evaluations. The LCBI values in carotid arteries are consistent with pathological evaluations.

**Keywords:** Carotid artery stenosis, Lipid plaque, NIRS-IVUS

**Oral Presentations 9**

**CAS**

**O9-1**

**A case of in-stent protrusion after carotid artery stenting for high echoic plaque**

Keisuke Imai1, Naoki Tokuda1, Kazuma Tsuto1, Atsushi Yamamoto1, Tetsuya Ioku1, Toshi Sai1, Kanako Menjo1, Masanori Cho1, Ryota Ueda1, Masashi Hamanaka2

1Department of Neurology and Stroke Treatment, Kyoto Daich Red Cross Hospital, Kyoto, Japan, 2Department of Neurology, Kyoto Daini Red Cross Hospital, Kyoto, Japan

A 79-year-old woman underwent carotid artery stenting (CAS) for progressive asymptomatic stenotic lesion on the right side, whose property was regarded as high echogenicity by preoperative carotid ultrasonography (CUS). During the procedure closed stent, Carotid Wallstent (CWS) 10/20mm, was deployed followed by post-dilatation under distal balloon protection. Angiography immediately after CAS demonstrated sufficient dilatation of the calcified stenotic lesion without apparent findings such as in-stent plaque protrusion (ISP) and fracture of the stent-struts. Her postoperative process was good, but MR diffusion-weighted imaging (DWI) showed multiple high signal intensities in the right hemisphere and CUS revealed ISP without mobility on the second day. 3D-angiography confirmed ISP and intravascular ultrasonography (IVUS) revealed ISP with high echogenicity on the seventh day. Second CAS using additional two pieces of CWS followed by post-dilatation was attempted and IVUS confirmed disappearance of ISP immediately after the procedure. DWI and CUS on the following day after the second procedure demonstrated no high signal intensities in the right hemisphere and recurrence of ISP, respectively. This case suggests that ISP with high echogenicity can occur after CAS without stent fracture even when preoperative CUS showed high echoic plaque.

**Keywords:** carotid artery stenting, in-stent protrusion, high echoic plaque

**O9-4**

**A case of subacute stent thrombosis followed up by carotid ultrasonography and TCD**

Natsuki Nakagawa1, Ayano Hashizume2, Naomi Sugita1, Rie Sendai1, Hiroomi Shimotsuka1, Soushi Okamoto2, Kunitaka Maruyama3, Masaki Kou3, Michiya Kubo3, Eisuke Furui2

1Dept of Clinical Laboratory, 2Dept of Stroke Neurology and 3Dept of Neurosurgery, Saiseikai Toyama Hospital, Toyama, Japan

A 79-year-old man underwent right CAS for recurrent stroke under both clopidogrel, cilostazol and aspirin. Carotid ultrasonography and MRI on the next day showed no abnormalities. However, 9 days after the procedure, carotid ultrasonography displayed both an increased 209cm/s of PSV and an abnormal mobile structure suspected to be a thrombus in the stent. TCD detected 9 MES per 30 minutes from the right MCA. MRI revealed an increase of new infarct foci in the right cerebral hemisphere. Then argatroban was added and aspirin was increased on the same day. The thrombus remained unchanged. After 1 month of CAS, an increase in the brightness of the thrombus was observed, followed by a decrease in PSV and a thrombus shrinkage. After 3 months, the disappearance of the thrombus was confirmed. During this period, although a small number of new infarct foci increased in the right cerebral hemisphere, no obvious neurological deteriorations happened. We experienced and reported a case of subacute stent thrombosis followed up by carotid ultrasonography and TCD.

**Keywords:** Subacute stent thrombosis, Carotid ultrasonography, Transcranial Doppler (TCD)
Oral Presentations 10

Right-to-left shunt

O10-3
Checklist for right-to-left shunt’s detection is useful in the standardization of examination maneuver using TC-CFI

Hidetaka Mitsumura, Ayumi Arai*, Maki Tanabe, Takeo Sato, Hiroki Takatsu, Teppei Komatsu, Kenichiro Sakai, Yasuyuki Iguchi
Department of Neurology, *Radiology, The Jikei University School of Medicine, Tokyo, Japan

Purpose: Our aim of this retrospective study is to analyze checklist for the standardization of examination maneuver of right-to-left shunt (RLS)’s detection using transcranial color flow imaging (TC-CFI).

Methods: We guided house stuff for RLS evaluation using checklist according to overseas guideline as follows; 1) insert over 20-gauge needle into right cubital vein, 2) exchange 1ml air/9ml saline mixture vigorously between the syringes at least ten times, 3) injection agitated saline immediately as a bonus, and perform single test without Valsalva maneuver (VM)/triple tests with VM monitoring at middle cerebral artery and intracranial vertebral artery, 4) the VM should start 5s after the beginning of the agitated saline injection and should be maintained for at least 5s. After examination, checklists were collected, and then we analyzed compliance rate of maneuver, failure items, and detectable rate of RLS before and after introduction of checklist.

Results: From September 2019 to January 2020 during using checklist, we examined 116 subjects (male 76, mean age of 71 years). The collection rate of checklist was 77%, and cases of all maneuver. Intravenous catheterization into right cubital vein was most common fail item (19 cases). The RLS decidable rate before introduction of checklist showed a tendency to be higher than that after introduction (p=0.08).

Conclusion: The standardization of examination maneuver using checklist for RLS detection is useful for improving diagnostic ability.

Keywords: right-to-left shunt, TC-CFI, contrast MES

O10-4
Diagnosis of indications for patent foramen ovale closure by transcranial-color flow image

Ayako Kuriki¹, Yuki Kamiya¹, Kenichiro Tanaka¹, Yoshifumi Miyauchi¹, Keita Mizuma², Hiroyasu Komuro¹, Saori Fukuda¹, Takashi Fujii¹, Yuta Kato¹, Takahide Wada¹, Kenjiro Ono²
¹Department of Neurology, Showa University Kototoyosu Hospital, Tokyo, Japan
²Division of Neurology, Department of Medicine, Showa University School of Medicine, Tokyo, Japan
³ Department of Neurology, Kanto Rosai Hospital, Kanagawa, Japan

Background: With the introduction of percutaneous foramen ovale closure for cryptogenic stroke, closure of the foramen ovale with a large shunt has been recommended. Transcranial color Doppler (TCD) has been recommended as a noninvasive method of shunt diagnosis. We performed shunt diagnosis by transcranial color flow imaging (TC-CFI), which is easier to perform than TCD, and investigated the relationship between large shunt (>20 bubbles) detected by transesophageal echocardiography (TEE), the amount of high intensity signal (HITS) by TC-CFI.

Methods: We included 132 patients with cerebral infarction/TIA who were hospitalized and underwent TEE between June 2016 and December 2017.

TEE and TC-CFI were performed on the same day, with a bubble study with Valsalva maneuver by observation at middle cerebral artery or vertebrobasilar artery. TC-CFI-Grade was classified as Grade I (1-10 HITS), Grade II (>10 HITS, not Curtain), and Grade III (Curtain) according to the number of HITS observed in 30 seconds in TC-CFI, as in TCD-Grade.

Results: The sensitivity of large shunt in TC-CFI-HITS-positive was 100%. In the 12 cases of large shunt, 3 cases showed Grade I, 8 cases showed Grade II, and 1 case showed Grade III by TC-CFI.

Conclusion: Large shunts were detected by TC-CFI with a sensitivity of 100%. It is important to be positive regardless of amount of HITS.

Keywords: transcranial color flow image, patent foramen ovale, transesophageal echocardiography

O10-5
The utility of ultrasound of internal carotid artery for diagnosis of paradoxical embolism

Ayano Suzuki¹,², Hidehiro Takekawa¹,²,³, Keisuke Suzuki¹, Akio
Purpose: The aim of this study was to assess the right-to-left shunts (RLs) associated with patent foramen ovale (PFO), which is essential for diagnosing paradoxical cerebral embolisms. Transcranial Doppler (TCD) and transesophageal echocardiography (TEE) are used for the detection of RLs. We compared the efficacy of carotid artery ultrasonography (C-US) and TEE in terms of the detection rate of PFO.

Methods: Ninety-four consecutive patients with ischemic stroke were evaluated for PFO through TEE and C-US. In a TEE assessment, the diagnosis of PFO was made using the Valsalva maneuver with contrast agent injection. The internal carotid artery was evaluated with C-US. PFO was defined as the appearance of microembolic signals (MES) after release of Valsalva load with contrast agent injection.

Results: PFO was detected in 30 patients. MES were observed in 47 patients using C-US. For the diagnosis of PFO, C-US had 83.3% sensitivity, 65.6% specificity, 53.2% positive predictive value (PPV), and 89.4% negative predictive value (NPV). In the 80 patients with large shunt, sensitivity, specificity, PPV, and NPV were 75.0%, 65.6%, 35.3%, and 91.3%, respectively.

Conclusion: Our study suggests that C-US with Valsalva load release and contrast agent injection is beneficial for the diagnosis of PFO.

Keywords: patent foramen ovale, right-to-left shunts, carotid artery ultrasonography

O10-6
PSUP can detect more microembolic signals via right-to-left shunt than TCD (second report)

Ryotaro Mizuno, Maki Tanabe, Ayumi Arai, Takeo Sato, Tepppei Komatsu, Kenichiro Sakai, Jun Kubota, Hidetaka Mitsumura, Yasuyuki Iguchi

1 Department of medicine, 2 Department of Neurology, 3 Radiology, The Jikei University School of Medicine, Tokyo, Japan, 4 Hashimoto electronic industry, Japan

Objective: We reported that right-to-left shunt (RLS) search by paste-able soft ultrasound probe (PSUP) was clinically useful than by TCD, but waveform attenuation and artifact during Valsalva maneuver (VM) were problem in this past annual meeting. In this study, we considered the way of these problems, and then analyzed usefulness of PSUP by increasing the number of cases.

Methods: The subjects were patients with acute ischemic stroke or transient ischemic attack who had one or more contrast microembolic signals (cMES) in middle cerebral artery (MCA) by RLS screening test on administration. We monitored blood flow of unilateral MCA by TCD and ipsilateral common carotid artery by PSUP simultaneously. After injection contrast agent, a single test without VM and triple tests with VM were performed. When the waveform was attenuated by PSUP during VM, manual correction was performed temporarily. After that, we compared the number of cMES between TCD and PSUP.

Result: A total of 156 examinations on 39 patients (32 males, median age of 60 years) were evaluated from August 2015 to May 2020. The number of cMES on PSUP was significantly larger than that of TCD in all of 156 examinations (1662 vs 1174, p<0.01), in 39 examinations without VM (483 vs. 207, p=0.03), and in 117 examinations with VM (1179 vs 967, p<0.01).

Conclusion: PSUP examination can detect more cMES than TCD for RLS diagnosis.

Keywords: PSUP, right-to-left shunt (RLS), microembolic signals (MES)

O10-7
Micro bubble test using carotid ultrasonography for detection of RL shunt in embolic stroke patients

Naoki Tokuda, Keisuke Imai, Kazuma Tsuto, Atsushi Yamamoto, Tetsuya Ioku, Ryota Ueda, Toshi Sai, Kanako Menjo, Masanori Cho, Masashi Hamanaka

1 Department of Neurology and Stroke Treatment, Kyoto First Red Cross Hospital, Kyoto, Japan, 2 Department of Neurology, Kyoto Second Red Cross Hospital, Kyoto, Japan

Purpose: The purpose of this study is to clarify sensitivity of micro bubble test using carotid ultrasonography (MBT-CUS) compared with using transesophageal echocardiography (MBT-TEE) for detection of right-to-left shunt (RLS).

Methods: Consecutive acute embolic stroke or TIA patients admitted to our institute from April 2014 to March 2019 were reviewed. Their medical records were retrospectively assessed to compare MBT-CUS with MBT-TEE. In the MBT-CUS, microembolic signals were searched by the probe on the ipsilateral CCA to ischemic lesion or dominant VA. RLS was stratified into three categories: 5 or less (grade 1), 6-20 (grade 2), and 21 or more (grade 3) bubbles in the left atrium detected by trans-
esophageal echocardiography.

**Results:** Of 99 patients, RLS was detected in 52 patients by MBT-TEE and 20 patients by MBT-CUS. Sensitivity and specificity of MBT-CUS compared with MBT-TEE to detect RLS were 38% and 100%, respectively. Classifying above three categories, the sensitivities were 2/30 (7%) in grade 1, 7/11 (64%) in grade 2, and 11/11 (100%) in grade 3.

**Conclusions:** Although sensitivity of MBT-CUS to detect RLS was low, it was very high as 82% (18/22) limited in high grade shunt. MBT-CUS can be a substitute for MBT-TEE in detecting high grade RLS.

**Keywords:** right-to-left shunt, carotid ultrasonography, micro bubble test

---

**Oral Presentations 11**

**Treatment and ultrasound**

**O11-4**

**The role of intraoperative echo-assist with navigation surgery in a case of cystic cerebellar tumor**

Hidemasa Nagai, Kazuhiro Yamamoto, Mizuki Kambara, Shouko Urushimatsu, Yuta Fujiwara, Masahiro Tsuji, Hirotake Eda, Fumio Nakagawa, Tsutomu Yoshikane, Takeshi Miyazaki, Yasuhiro Akiyama

Department of Neurosurgery, Shimane University Faculty of Medicine, Japan

**Purpose:** Intraoperative navigation is now essential for neurosurgical operations, but its main disadvantage is brain-shift. Intraoperative MRI can be used to compensate for the degree of brain-shift, but it is inconvenient and cannot be done in real time. On the other hand, intraoperative ultrasound is simple and easy to apply, and facilitates real-time examination. We therefore considered that intraoperative ultrasound could be useful for assisting navigation in this setting. Here we report the use of ultrasound-assisted navigation for cyst puncture in a case of cerebellar cystic tumor.

**Patient material:** A female patient in her 50s with a history of breast cancer presented with dizziness and gait disturbance. A metastatic cerebellar tumor was diagnosed, and the patient underwent whole-brain irradiation. Later, however, her consciousness suddenly deteriorated due to cyst growth and hydrocephalus. She was therefore transferred to our department for urgent neurosurgery.

**Operation:** Posterior fossa craniotomy was performed under intraoperative navigation. We punctured the tumor cyst under echo-assisted navigation and confirmed immediate shrinkage of the cyst using ultrasound, allowing total removal of the tumor.

**Conclusion:** Navigation assisted by real-time ultrasound is advantageous for removal of cystic brain tumors, and is expected to become standard in the Reiwa era.

**Keywords:** cyst, echo-assist, navigation

**O11-6**

**Development of gene transfer into astrocyte cell line using Non-liposomal nanobubbles**

Hiroshi Kida, Hitomi Endo, Loreto B Feril, Katsuro Tachibana

Department of Anatomy, School of Medicine, Fukuoka University, Fukuoka, Japan.

**Purpose:** For efficient gene transfer using ultrasonic responsive bubble, liposomal nanobubbles (L-NBs) encapsulated in a lipid bilayer membrane is used mainly. There were problems such as complicated synthesis process and tissue damage. The purpose of this study is to develop a highly efficient and low-damage gene transfer method using non-liposomal nanobubbles (nL-NBs).

**Methods:** nL-NBs containing C3F8 was prepared by the Super High Speed Vibration Bubbling (SHiSViB) method. The nL-NBs solution was filled in the well of a 96-well cell culture plate in which C8-D1A (spontaneously immortalized astrocyte) was cultured. The pNL1.3.CMV [secNluc] CMV plasmid was transferred by ultrasonic irradiation. The efficiency was evaluated by the reporter assay and the cell viability was evaluated by the MTT assay.

**Results:** Emission of 1x10^5 RLU or more was measured by ultrasonic irradiation at 5W/cm2, duty ratio 50%, and 20 seconds. It was possible to transfer genes equal to or higher than the existing L-NBs. The cell viability was 76.2%, which was a significant improvement compared to the existing L-NBs (60.2%).

**Conclusions:** Highly efficient and low-damage gene transfer by nL-NBs was developed. Clinical application can be expected as a minimally invasive therapeutic gene transfer method for local lesions such as brain tumors.

**Keywords:** Non-liposomal nanobubble, Sonoporation, Gene therapy
Oral Presentations 12

Microembolic signal

O12-3
Direct monitoring using PSUP can detect microembolic signals from the internal carotid artery stenosis

Maki Tanabe\(^1\), Ayumi Arai\(^2\), Jun Kubota\(^3\), Takeo Sato\(^4\), Teppei Komatsu\(^5\), Kenichiro Sakai\(^6\), Hitotaka Mitsumura\(^7\), Yasuyuki Iguchi\(^8\)
\(^1\)Department of Neurology, \(^2\)Radiology, The Jikei University School of Medicine, Tokyo, Japan, \(^3\)Hashimoto electronic industry, Japan

A 77-year-old man, who visited hospital with chief complaint of difficulty in speech since one month ago. Neurological examination on admission showed only aphasia, and NIHSS score was 1. Because MRI revealed ischemic stroke in the left frontal and subparietal lobe, cilostazol 200mg/day was started. MRI on the second day of admission showed hemorrhagic transformation and new infarction in the left parietal cortex. Stenosis with turbulence and increased blood flow from the bifurcation of the left common carotid artery to the origin of the internal carotid artery (ICA) was seen in carotid ultrasonography, and then monitoring at the left middle cerebral artery by transcranial Doppler (TCD) showed 9 microembolic signals (MES). On the third day, 5 MES were seen in monitoring of left ICA after stenosis using pastable soft ultrasound probe (PSUP) for evaluating embolus from ICA origin part directly. Therefore aspirin 200mg/day was added to cilostazol. MES were not seen on the 16th day by TCD suggesting that the treatment stabilized the plaque. On the 23rd day, carotid endarterectomy was performed for left ICA stenosis. Because of poor temporal bone window in Japanese elder patients, some cases may be impossible to monitor MES by TCD. On the other hand, we could detect MES from plaque of ICA origin part by PSUP in this case.

Keywords: internal carotid artery stenosis, microembolic signals (MES), pastable soft ultrasound probe (PSUP)

Oral Presentations 13

Carotid ultrasonography 2

O13-1
Vascular stiffness, evaluation of the cut off value in healthy Japanese

Yoko Okada, Michiya Igase, Yasuharu Tabara, Masayuki Ochi, Yasumasa Ohyagi
Department of Neurology and Geriatric medicine, Ehime University, Ehime, Japan

Purpose: The indices for arterial stiffness in carotid ultrasound are not fully standardized. We examined cut off value of those stiffness parameter in middle-aged to elderly general population.

Methods: Arterial stiffness parameters were assessed by carotid ultrasound e-tracking system (ē-10 ultrasonography, Aloka Co, Ltd, Tokyo, Japan). The study subjects were 2125 healthy individuals consecutive participants in the medical checkup program at Ehime University Hospital Anti-aging Center, with a mean age of 65.3±9.6 years.

Results: The upper cut off limits of Ep, \(\beta\), and local PWV determined by the nonparametric method were 317.1, 23.8, and 11.2, respectively. The optimal cutoff values for the Suita score high-risk group and carotid IMT 1.0mm were examined with ROC curves, Ep 189.0 for the Suita score high-risk group and 209.5 for carotid IMT 1.0mm or more, \(\beta\) 13.6/13.6, and local PWV 7.6/8.4. Stiffness parameters increased with age, Ep and \(\beta\) were 1.5 times higher and local PWV was 1.3 times higher in patients in their 80s than in those in their 40s.

Conclusion: Ep was 200, \(\beta\) was 15, and local PWV was 8 were considered cutoff values for arterial stiffness, although the values would be slightly higher for the elderly.

Keywords: Arteriosclerosis, Vascular stiffness, e-tracking

O13-2
Evaluation of large vessel occlusion with carotid duplex ultrasound to select candidates for mechanical thrombectomy

Ryo Itabashi\(^1\), Yuya Shigehatake\(^1\), Takuya Saito\(^1\), Kaoru Endo\(^1\), Kazuki Fukuma\(^1\), Yuya Kobayashi\(^1\), Yuichi Kawabata\(^1\), Yukako Yazawa\(^1\), Manabu Inoue\(^2\), Masatoshi Koga\(^2\)
\(^1\)Departments of Stroke Neurology, Kohnan Hospital, Sendai, Japan, \(^2\)Department of Cerebrovascular Medicine, National Cerebral and Cardiovascular Center, Suita, Japan
Purpose: The aim of this study is to address the usefulness of carotid duplex ultrasound (CDU) for evaluating large vessel occlusion (LVO) in patients with acute stroke to be treated with mechanical thrombectomy (MT).

Methods: Stroke patients with NIHSS score of ≥ 6 and ASPECTS of ≥ 6, in whom MT could be initiated within 6 hours of onset, were enrolled. If the ratio of the end-diastolic velocity in the common carotid artery was greater than 1.4 or the diastolic flow in the internal carotid artery was not detected on CDU, patients were transferred to angio-suite immediately without additional vascular imaging.

Results: Forty-eight patients were finally enrolled. Twenty-seven patients were diagnosed as LVO by CDU. To identify the occlusion of ICA or M1 segment MCA, the sensitivity and the specificity of CDU were 82% and 80%, respectively. Door to puncture time was significantly shorter in patients evaluated by CDU only than in those evaluated by MRA after CDU (34 vs 47.5 minutes, p<0.001).

Conclusion: We demonstrated that CDU could reduce time metrics for early initiation of MT with enough positive predictive value to identify LVO.

Keywords: carotid duplex ultrasound, large vessel occlusion, mechanical thrombectomy

O13-6
A case of maximum peak systolic velocity in the distal part of internal carotid stenosis

Eriko Yamaguchi, Kozue Saito, Souhei Yoshimura, Kazuki Fukuma, Hirotu Shimizu, Mio Toyoyama, Mami Matsukawa, Masafumi Ihara, Masatoshi Koga
Department of Cerebrovascular Medicine and Neurology, National Cerebral and Cardiovascular Center, Japan

Blood flow velocity elevate in the most stenotic part of internal carotid artery stenosis (ICS) with ultrasonography. When occupancy rate of ICS plaque is greater than 50% at transverse scan, peak systolic velocity (PSV) on power doppler imaging and stenosis rate are measured. However, in Clinical maximum PSV is sometimes observed at distal part of ICS.

The case was a 79-year-old man with right asymptomatic ICS. Ultrasonography showed 85% Area and 74% ECST stenosis. PSV at ICS was 2.0m/s, but maximum PSV was 2.9m/s at the portion without stenosis 15mm distal to ICS. Plaque was iso-echoic with calcification and eccentric on far wall. Vector flow mapping (HITACHI LESEND 800) showed turbulent flow with swirling backflow after ICS, and flow appeared like that stenosis was continuous. Particle image velocimetry using eccentric plaque stenosis model showed elevated flow velocity in distal part without stenosis because the swirling created pseudo-stenosis.

In ultrasonography, internal carotid artery (ICA) generally travels outward toward deep like an arc. When eccentric plaque exist on far wall, blood flow after stenosis strike the near wall of arcuate ICA, bend and run deeper. It is important to evaluate carefully PSV because eccentric plaque generate turbulence and make PSV after ICS faster than that of the actual most stenotic part.

Keywords: carotid stenosis, peak systolic velocity, fluid dynamics

O13-7
Two Cases of internal carotid artery web (ICAW) treated by anticoagulation

Eisuke Furui1, Masaki Koh2, Soushi Okamoto2, Michiya Kubo2, Yukio Horie3
1Department of Stroke Neurology and 2Department of Neurosurgery, Saiseikai Toyama Hospital, Japan

Case 1. a 70-year-old woman with vascular risk factors of hyperlipidemia and smoking and past histories of both TIA and brain infarction in left MCA territory suffered from recurrent left MCA infarction under clopidogrel. CTA reveled a shelf-like intraluminal septum from the posterior wall of the left carotid bulb, and confirmed ICAW. Although we advised her to undergo CEA, she didn’t agree. No recurrence observed for 3.5 years under warfarin.

Case 2. a 43-year-old woman without vascular risk factors, was admitted for brain infarction in left MCA territory 3 days after the onset transient right hemiparesis. CTA suggested plaque at first, then showed ICAW at follow up. These change might describe the disappearance of thrombus on ICAW. She could not undergo CEA without recurrence for 2.25 years under warfarin.

ICAW is an atypical intimal fibromuscular dysplasia. CTA are effective for diagnosis. Compared to CTA, ultrasonography was equally effective in Case1, and less effective in Case 2. Ultrasonography detected no mobility of ICAW as expected form the thinness displayed by CTA. Risk of recurrence is high under antplatelets, and CEA and CAS are choice for prevention. Anticoagulation were effective in these 2 cases.

Keywords: internal carotid artery web, anticoagulation, carotid ultrasonography
O14-1
Usefulness of Superb Microvascular Imaging (SMI) in the evaluation of carotid plaque with ulceration

Hirokazu Tamura¹, Masahiro Uemura²,³, Kunio Motohashi⁴, Takeshi Fujimo⁵, Kiyoshi Onda⁶
¹Department of Medical Radiology, Niigata Neurosurgical Hospital, Niigata, Japan
²Department of Neurology, Niigata Neurosurgical Hospital, Niigata, Japan
³Department of Neurology, Brain Research Institute, Niigata University, Niigata, Japan
⁴Department of Neurosurgery, Niigata Neurosurgical Hospital, Niigata, Japan

Introduction: Function of superb microvascular imaging (SMI) can visualize the tissue with high temporal and spatial resolution. We investigated to apply the function of SMI for carotid ulcerative lesions (ULs).

METHODS: Subjects were patients with ULs evaluated using carotid ultrasonography at our hospital from January 2019 to January 2020. ULs were defined as obvious depression in either short or long axis irrespective of the size. We compared the size of ULs by using SMI and conventional B-mode. In addition, we also compared the images of ULs of SMI and magnetic resonance arteriography (MRA) of carotid artery.

Results: Forty-one ULs of 37 blood vessels (30 males, 5 females, average age 76 ± 7.4 years) were measured both by using SMI and B-mode simultaneously. The size of ULs in SMI was significantly decreased as compared those with B-mode. (2.2 ± 1.1 vs 2.1 ± 1.0, p <0.05). The other six lesions were only visualized by using SMI. Among 36 ULs which were available for the images both of SMI and carotid MRA, twenty ULs were visualized both with SMI and MRA (55.6%).

Conclusion: SMI can visualize the ULs which were difficult to visualize by using the conventional B-mode.

Keywords: Carotid Ultrasoundography, Superb Microvascular Imaging, Ulceration

O14-2
Cognitive decline related to flow volume of Internal carotid artery and Internal jugular vein

Utako Adachi¹,³, Eiko Higuchi¹, Misa Seki¹, Megumi Kubota¹,³, Yukiko Tsutsumi¹,², Yuka Shirai¹,², Sono Toi¹, Kenji Maruyama¹,³, Kazuo Kitagawa¹
¹Department of Neurology, Tokyo Women’s Medical University, Japan
²Department of Neurology, Tokyo Metropolitan Health and Hospitals Corporation Ohkubo Hospital, Japan
³Department of Neurology, Todachuo General Hospital, Japan
⁴Department of Neurology, Shiseikai Daini Hospital, Japan

Internal carotid artery (ICA) blood flow and internal jugular vein (IJV) blood flow were measured by ultrasonography to investigate the relationship with cognitive function tests.

Bilateral ICA blood flow and IJV blood flow were measured in all 110 cases (71 males,39 females, average age 71.8±9.6 years) who underwent ultrasonography at our hospital. Mini-Mental State Examination (MMSE) and Japanese version of Montreal Cognitive Assessment (MOCA-J) was enforced in all cases. The cut off values for mild cognitive impairment (MCI) were 27 points for MMSE and 25 points for MOCA-J, and they were classified into MCI (-) and (+) group, and comparative studies were conducted on ICA flow volume and IJV flow volume. We also investigated the correlation between MMSE and MOCA-J scores and ICA flow volume and IJV flow volume.

In the MMSE, a significant decrease in ICA flow volume was observed in the MCI (+) group (p =0.02). MOCA-J showed a significant decrease in IJV blood flow in the MCI (+) group (p<0.001). No correlation was found between MMSE score and ICA flow volume, but weak correlation was found between the MOCA-J score and IJV Blood flow (r= 0.3).

Keywords: MMSE, MOCA-J, Flow volume

O14-3
The feature of carotid mobile plaque in acute stroke patients

Ai Keito¹, Yuka Terasawa², Nobuko Hatano¹, Tatsuo Kotoriyama²
¹Department of clinical laboratory, Department of Neurology, Brain attack center Ota memorial hospital, Hiroshima, Japan
²Department of Neurology, Tokyo Women’s Medical University, Japan

Purpose: We report the details of the positive rate and features of mobile lesions in patients with cerebral infarction.

Method: From October 2018 to February 2020, we retrospectively checked all finding of patients who were admitted to our
hospital with ischemic stroke and underwent carotid ultrasonography (CUS). We enrolled the consecutive patients with mobile lesions and evaluated the image and prognosis.

**Results:** During the period, 1210 patients underwent CUS and 9 (0.7%) patients had mobile lesions. Eight patients had mobility in the first examination and one patient had mobility in the second examination. Of the 8 initial mobile lesions, 6 were Jellyfish-like mobile plaques and one was Oscillating Thrombus associated with acute internal carotid artery occlusion. The other was a mobile substance that adhered to the vessel wall. Two of the six Jellyfish plaques underwent Carotid endarterectomy by follow up. In the other 4 cases, mobility disappeared after a few days.

**Conclusion:** Since mobile lesions are findings that are directly linked to the treatment of patients, great care should be taken to eliminate oversights and careful follow up after discovery.

**Keywords:** mobile plaque, carotid ultrasonography, acute stroke

**O14-4**

A case of ulcer plaque with a peculiar morphology (Takotsubo type) found in a community hospital

Tomomi Sadasue$^1$, Megumi Kotoura$^2$, Atsuko Nosaka$^1$, Hiroshi Matsuo$^1$, Kenichi Yamamoto$^1$, Chie Mihara$^2$

$^1$Department of Laboratory, Hiroshima Kyoritsu Hospital, Japan
$^2$Department of Neurosurgery, Hibino Hospital, Japan

**Introduction:** Carotid ultrasonography is mainly requested from the medical checkup in our hospital, but it is also possible to examine emergency cases. We report a case of brainstem stroke with peculiar shaped plaque at the internal carotid artery.

**Case:** An 81-year-old man visited our hospital because of numbness in his right hand. Blood tests showed mild liver / renal dysfunction and dyslipidemia. No special notes on electrocardiogram and chest X-ray. DWI of MRI showed a fresh infarction in the left pons. A cervical MRA was suspected of stenosis at the origin of the right internal carotid artery. Carotid echo examination revealed a lump-shaped ulcer plaque, which we named “Takotsubo shape”, with no mobility. Conservative treatment was started with the diagnosis of left pontine infarction.

**Discussion:** Deep ulcers can form emboluses inside and drain into the internal carotid artery. In this case the onset was a pontine infarction, and fortunately no cerebral infarction occurred. But if the diagnosis was delayed, extensive cerebral infarction may have occurred. In local medium-sized hospitals, there are usually few neurologists or neurosurgeons, even the equipment for diagnosing acute stroke such as CT, MR, and echo is available. So we need a system for urgent diagnosis with specialists.

**Keywords:** carotid artery, ulcer plaque, Takotsubo shape

**O14-8**

Clinical significance of intra-plaque neovascularization in patients with carotid artery stenosis

Mayu Ishikawa$^1$, Hiromi Kan$^1$, Yoshiaki Kumon$^2$, Keiji Igase$^2$, Nari Kimura$^2$, Ichiro Matsubara$^2$, Takanori Ohnishi$^2$, Kazuhiko Sadamoto$^2$

$^1$Department of Clinical laboratory, $^2$Department of Neurosurgery, Washokai Sadamoto Hospital, Japan

**Purpose:** Sequential changes in carotid artery plaques were observed to reveal the clinical significance of intra-plaque neovascularization (IPNV).

**Methods:** Ninety-three carotid artery stenoses (89 patients, ≥30% stenosis) were followed using carotid ultrasonography. Intra-plaque blood flow on B-flow imaging was defined as IPNV. According to IPNV presence, plaques were divided into two groups, and plaque characteristics and clinical findings were compared. The mean follow-up periods were 22.2 and 22.8 months in the IPNV(+) and IPNV(−) groups, respectively.

**Results:** 1) IPNV was observed in 32/93 lesions (31/89 patients). No significant differences were present between patients’ backgrounds in the two groups. Echo-lucent plaques were observed more frequently in the IPNV(+) group (n=24) than in the IPNV(−) group (n=30) (p=0.014). Ulceration was observed more frequently in the IPNV(+) group (n=7) than in the IPNV(−) group (n=2) (p=0.006). 2) With follow-up, plaque volume increased more frequently in the IPNV(+) group (n=12) than in the IPNV(−) group (n=6) (p=0.002). New cerebral infarctions on magnetic resonance images were recognized in one patient per group, although symptomatic infarction was not observed in any patients.

**Conclusions:** Carotid artery plaques with IPNV showed an increase in plaque volume, and may indicate high risk for ischemic stroke.

**Keywords:** carotid artery stenosis, intra-plaque neovascularization, ultrasound imaging