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Abstracts

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Current implications of cerebral revascularisation; 8 years of experience in Lausanne and Geneva

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During the past 10 years there has been a revival of interest in cerebral revascularisation (CR). To determine the current indications for CR, we retrospectively evaluated 20 consecutive patients operated between June 1997 to June 2005 at our centres. There were 11 males and 9 females. The preoperative work-up included CT angiography, intra-arterial angiography and brain perfusion studies. The mean age was 45. Two patients underwent two separate CR procedures. The indications were complex intracranial aneurysms (14 cases), Moya Moya syndrome (4 surgeries in 3 cases) and arterial occlusive diseases (4 surgeries in 3 cases). The techniques included 19 extracranial to intracranial bypasses (STA-MCA anastomosis in 13 cases, ECA-ICA in 6 cases [radial graft in 4 and saphenous vein in 2]) and 3 intracranial to intracranial bypasses (side-to-side anastomosis in 2 and end-to-end in one case). The immediate patency rate was 95.4%. Two patients experienced cerebral infarction and one exhibited hyperperfusion haemorrhage. Eighteen out of 20 patients had improved or stable postoperative status. Two patients died during follow-up. One due to the severity of primary haemorrhage and the other as a result of other medical problems. The indications of CR should be carefully assessed by cerebral blood-flow studies. Bypass surgery appears to be an appropriate treatment in selective cases of complex aneurysms or arterial occlusive disease when medical or endovascular treatment has no option to offer.

Vertebral artery dissection: presenting findings and predictors of outcome in 189 consecutive patients

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Background: Few data exist about clinical outcome and its predictors in patients with spontaneous vertebral artery dissection (sVAD).

Patients and methods: Clinical, imaging and outcome data and its predictors were investigated.

Results: A total of 189 patients, 103 men and 86 women with 215 sVAD were identified. Brain ischaemia occurred in 149 patients (80%; ischaemic stroke, n = 131, 70%; TIA, n = 18, 10%). Three patients with ischaemic stroke showed also SAH on brain imaging. Additional 3 patients (2%) had subarachnoid haemorrhage without ischaemia. Ischaemic or haemorrhagic symptoms were associated with pain in 135 (89%) and pulsatile tinnitus in 7 (5%) patients. Remaining 37 patients had isolated head and/or neck pain in 22 (11%), asymptomatic sVAD in 14 (7%) and cervical radiculopathy in one case.

Location of VAD was more often in the V2 (33%) or V3 (33%) than in the V1 (20%) or V4 segment (14%), (p = 0.001). Most infarcts were located in the territory of the posterior inferior cerebellar artery (n = 96, 73%). Outcome was favourable (modified Rankin Scale score 0 or 1) in 100 (81%) of 123 ischaemic stroke patients with follow-up, and two (2%) patients died. Low NIHSS score on admission was an independent predictor of a favourable clinical outcome (p > 0.0001).

Conclusions: SVAD is predominantly located in the V2 or V3 segment and causes mainly posterior circulation stroke. Favourable outcome is observed in most ischaemic strokes and independently predicted by low NIHSS score.

Gender differences in spontaneous cervical artery dissection

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Background: Gender differences have not been systematically analysed in spontaneous cervical artery dissection (sCAD).

Methods: Clinical and imaging findings of 698 consecutive sCAD patients were recorded. Clinical outcome of ischaemic stroke patients (n = 408) was analysed at 3 months using the modified Rankin scale (mRS). Data were compared between the two sexes.

Results: Of a total of 696 patients, 399 (57%) were men and 297 (43%) women (p < 0.0001). Women were younger than men (42.5 ± 9.9 years versus 47.5 ± 9.3 years; p < 0.0001). Men showed a higher frequency of hypertension (31% versus 15%; p < 0.0001), and migraine was more frequent in women (47% versus 20%; p < 0.0001). Presenting symptoms and signs were similar in both sexes except for a higher frequency of pulsatile tinnitus in women (16% versus 8%; p = 0.001). Multiple dissections occurred more often in women than in men (18% versus 10%; p = 0.001). The percentage of stroke patients with a favourable outcome at 3 months (mRS 0 or 1) did not differ between women (58%) and men (54%; p = 0.51).

Conclusions: Women with sCAD are younger than men and have more often multiple dissections. The usual female preponderance of migraine and a male preponderance of hypertension were observed. There were no major differences based on gender in presenting symptoms and signs or functional clinical outcome.

Natural course of isolated limb monoparesis due to ischaemic stroke

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Isolated hand palsy due to ischaemic stroke is often evaluated for intravenous thrombolysis (IVT). The authors investigated the aetiology, anatomical localisation and 3-month outcome in stroke patients with limb monoparesis.

Data of 4490 stroke patients were prospectively collected. Stroke aetiology was determined using the TOAST-criteria. For clinical evaluation the National Institute of Health Stroke Scale (NIHSS) and the modified Ranking Scale (mRS) were used.

48 (1.1%) of 4490 consecutive stroke patients presented with monolimb paresis. 4 patients were excluded. Mean initial NIHSS score was 1.6 ± 0.8 (0–4), mean mRS score was 2.2 ± 0.7 (1–3). DWI-MRI showed acute infarcts in 38 (92%) of 41 patients that underwent MRI. 37 (97%) had cortical lesions of the paracentral region. 3 subjects who underwent brain CT had cortical, precentral lesions. Infarct localisation in 3 patients remained unclear. Presumed aetiology of stroke was large artery sclerosis in 19 (43%), cardiac embolism in 6 (13%), small artery disease in one (2%) and undetermined cause in 18 subjects (41%). At discharge 25 patients (56%) had recovered completely. At three-month follow-up there were no residual neurological deficits (mRS = 0) in 32 (82%), mild symptoms (mRS 1) in 5 (13%) and a moderate deficit (mRS 2) in 2 (5%) of 39 cases.

Ischaemic stroke causing monolimb paresis is mainly of embolic origin, located in the central cortical region and typically has a benign outcome suggesting that IVT is not indicated.

IV thrombolysis in stroke patients ≥ 80 versus <80 years of age – a systematic review across cohort studies

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Objective: Elderly stroke patients were excluded or underrepresented in the randomised controlled trials of iv thrombolysis with recombinant tissue plasminogen activator (rtPA) applied within 3 hours. Cohort studies comparing iv rtPA in stroke patients aged ≥ 80 versus <80 were limited by small sample sizes. A systematic review across such studies was done.

Methods: A systematic literature search (PubMed; Science Citation Index) was done to retrieve all eligible studies (last search November 23, 2005). Two reviewers independently extracted data on “death”, “favourable 3-month outcome (modified Rankin Scale 0–1)”, and “symptomatic intracranial haemorrhage (sICH)”. Across studies, Peto Odds ratios (OR) with 95% Confidence intervals (95% CI) were calculated.

Results: Five cohort studies ($n = 1021$ patients) were included. Compared to younger patients, older patients had a 3.96 times (95% CI 2.44–6.42) higher mortality rate. No significant differences were shown for “favourable outcome” (OR = 0.69; 95% CI 0.45–1.07), “favourable outcome among survivors” (OR = 0.95; 95% CI 0.59–1.53) and for “sICH” (OR = 1.25; 95% CI 0.64–2.42).

Conclusion: This systematic review showed that (1) stroke patients ≥ 80 years receiving rtPA have a higher mortality risk than younger patients, (2) the likelihood of favourable outcome among survivors as well as the risk for sICH is similar in both age groups.

Epidemiology of aphasia due to first ischaemic stroke

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Objective: In a geographically defined population we assessed incidence and determinants of aphasia due to first-ever ischaemic stroke (FEIS).

Methods: A one-year prospective, population-based study among the permanent residents of the canton Basle-City, Switzerland, was performed using multiple overlapping sources of information.

Results: Among 188015 inhabitants, 269 patients had FEIS, of which 80 (30%, 95% CI 24–36) had aphasia. The overall incidence rate of aphasia due to FEIS amounted to 43 per 100000 inhabitants (95% CI 33–52). Aphasic stroke patients were older than non-aphasics. The risk of aphasia increased by 4% (95% CI 1–7) per each year of age of stroke patients. An association between gender and risk for aphasia could not be confirmed. Neither gender nor age had an effect on severity or fluency of aphasia. Cardioembolism was more frequent in aphasic stroke patients than in non-aphasic ones (OR 1.85; 95% CI 1.07–3.20). Aphasic patients were more likely to receive thrombolysis than non-aphasics (OR 4.7; 95% CI 1.5–15.4).

Conclusion: Annually, 43 of 100000 inhabitants had aphasia due to first ischaemic stroke. Advancing age was associated with an increased risk of aphasia. Severity and fluency of aphasia were not affected by demographic variables. Cardioembolism represents the major stroke aetiology and should be sought for. The presence of aphasia increased the odds for thrombolysis.

Mechanical thrombectomy for recanalisation in acute cerebrovascular stroke: preliminary results with a dedicated animal model

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Background: Recent studies have focused on mechanical thrombectomy for fast recanalisation in acute stroke. To date no systematic in vivo evaluation has been made of the different mechanical devices in this novel field of endovascular interventions. We developed a specific animal model for mechanical thrombectomy that allows visualisation of thrombus-device interaction during retrieval.

Methods: Angiography and embolisation with a preformed thrombus were performed in eight pigs. The thrombus was generated by mixing 25 IU bovine thrombin and 10 ml autologous blood. For visualisation during angiography 1 g barium sulfate was added.

Results: The preformed thrombus exhibited mechanical stability, reproducibility and high X-ray absorption, providing excellent visibility during angiography. The setting allowed selective embolisation of targeted vessels without thrombus fragmentation. Preliminary results on different retrieval devices elucidated the thrombus-device interaction and thrombus fragmentation during retrieval.

Conclusion: The model presented allows selective and reliable thromboembolisation of vessels that reproduce the anatomical and haemodynamic situation in acute cerebrovascular stroke. It permits visualisation of the thrombus during angiography and intervention, providing unique insight into the behaviour of both thrombus and device, highly useful in the development and evaluation of mechanical clot retrieval in acute cerebrovascular stroke.

Carotid artery stenting versus carotid endarterectomy – a prospective, randomised trial with long-term follow-up (BACASS)

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Objective: In a randomised, prospective single-centre trial, safety and efficacy of percutaneous carotid artery stenting (CAS) was compared with carotid endarterectomy (CEA).

Material and methods: Twenty symptomatic patients with stenosis $>70\%$ of the extracranial internal carotid artery were prospectively randomised to either CEA ($n = 10$) or CAS ($n = 10$). Follow-up examinations included clinical neurologic and carotid ultrasound examinations. Corresponding neurological symptoms and patency of the treated artery were recorded for a follow-up period up to 6 years.

Results: There were no periinterventional complications in CAS. One patient treated

with CEA developed an ipsilateral major stroke 16 days after the procedure. Time between procedure and discharge was 3.5 + 1.8 days regarding CAS and 7.3 + 3.3 days regarding CEA. Mean follow-up period was 48.1 + 21.3 months with CAS and 43.5 + 19.5 months with CEA. Two patients treated with CEA showed recurrence of stenosis up to a degree of 70%, one patient after CAS treatment showed a restenosis of 40%.

Conclusion: CAS is at least equivalent compared to CEA regarding perioperative safety as well as patency and stroke prevention in the long-term follow-up with reduced hospitalisation.

Circadian and seasonal variation of ischaemic stroke onset – an 8-year survey from the Basel stroke registry

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Background: In 1995, the Basel Stroke registry was established in order to systematically assess admission of acute stroke patients in the Basel Stroke Unit.

Patients and methods: From March 1995 to March 2003, data of 2603 patients with ischaemic stroke were prospectively registered. In 1714 patients (65.8%), symptom onset was exactly known. Stroke syndromes were classified according to the Oxfordshire Community Stroke Project and correlated with time and day of emergency admission. Chi-square statistics were applied.

Results: 785 patients entered the hospital within 3 hours (45.8%). Stroke onset was not equally distributed over the week and the year, respectively. More strokes than expected occurred on Tuesdays and from March (+21.3%) to May (+10.7%). Stroke syndromes were equally represented without difference in gender over daytime, weekday as well as over the year.

Conclusions: Most strokes occur on Tuesdays and within the months March to May. Almost half of the patients arrive at the emergency room within 3 hours of onset, if symptoms were noticed. In one third of the patients with confirmed ischaemic stroke, the occurrence time is unknown. There was no daytime, weekday or seasonal variation of stroke syndromes.

Perfusion CT shows hypoperfusion during reversible posterior leukoencephalopathy syndrome

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Background: Reversible posterior leukoencephalopathy syndrome (RPLS) is characterised by altered mental function, seizures,

cortical visual symptoms and headaches. We correlate clinical, perfusion CT (PCT) and MRI findings in three patients with RPLS and symptoms lasting from 12 hours to 4 days.

Patients and methods: Patient 1: A 61-year-old female patient without known risk factors presented sudden cortical blindness and confusion, very high blood pressure (BP) and six hours later had two generalised seizures. Acute PCT showed bilateral occipital hypoperfusion. Diffusion-weighted (DWI) MRI on day 4 was normal, T₂-weighted (T₂W) imaging showed bioccipital white matter changes. Patient 2: A 61-year-old male patient with hypertension and colon adenocarcinoma had a generalised seizure followed by cortical blindness at the end of a 5FU infusion. Acute PCT showed widespread bilaterally decreased parieto-occipital flow. DWI and T₂W on day 2 were normal. Patient 3: An 87-year-old hypertensive female patient, anticoagulated for chronic atrial fibrillation, was found with confusion, bilateral incomplete hemianopia and very high blood pressure. Acute PCT showed patchy occipital hypoperfusion. DWI on day 4 was normal, CT and T₂W showed diffuse leukoencephalopathy.

Conclusion: Perfusion CT in acute RPLS shows bilateral posterior hypoperfusion. This hypoperfusion seems to be different from ischaemic stroke, as it does not result in DWI lesions nor does it respect vascular territories.

Knowledge and prevalence of TIA in the Swiss population above 55 years

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Background: Knowledge about TIA may influence utilisation of highly effective secondary prevention. In a recent US survey, only 9% of the adult population knew the meaning of TIA, and 6.6% above age 55 were once given a diagnosis of TIA.

Methods: A telephone survey of non-institutionalised persons above 55 years of age living in Switzerland was performed. Demographic data as well as risk factors, knowledge of the meaning of TIA, of its symptoms and its prevalence were collected. Descriptive and comparative statistics were used.

Results: Among 1002 persons with a mean age of 68.5 (± 0.3) years, 51% knew the meaning of TIA, and two thirds knew at least one of its cardinal features. Knowledge was significantly better in the German-speaking than in the French-speaking regions; however, it was not better in patients with previous TIAs or strokes nor in patients with one or several risk factors. 6% of the population had had symptoms compatible with TIA in the past and 4.4% had once been given a diagnosis of TIA. Of patients with TIA, 64% saw a physician within 24 hours, and 14% later than 7 days.

Conclusion: Understanding of the term “TIA” is better in Switzerland than in a recent US survey, but knowledge about symptoms is poor, especially in the French-speaking regions. Patients with a diagnosis of TIA are not more knowledgeable despite their higher risk. The 4.4% prevalence of TIA is similar to that reported in other parts of the world.

Inappropriate closure of PFO

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Background: Effective prevention of PFO-related strokes depends on the correct initial diagnosis.

Methods: Medical records and follow-up data were reviewed of all patients who underwent PFO closure at a single institution. Only patients with presumed cerebrovascular symptoms and a presumed high risk of recurrence (associated atrial septum aneurysm, large shunt, recurrent events before closure) were eligible for closure. If neurological symptoms reoccurred after closure, a new thorough work-up was performed.

Results: From 228 patients with surgical (n = 107) or percutaneous (n = 121) PFO closure, follow-up data were available for 190 for a mean of 6.3 years. During follow-up 4 patients (2.1%) with inappropriate PFO closure were identified: a 35-year-old man with a mild hemiparesis was found to have multiple sclerosis; a 43-year-old woman with vertigo and gait ataxia was diagnosed with right peripheral vestibulopathy; a 41-year-old man with lacunar strokes was found to have CADASIL; and a 30-year-old man with a carotid territory stroke had severe genetic hyperhomocysteinaemia. Retrospectively, three of the four patients had neuroimaging findings before closure that were not compatible with embolic stroke.

Conclusions: We identified inappropriate closure of PFO in 2.1% of patients. A thorough initial work-up may avoid unnecessary interventions. Symptom recurrences after closure should prompt a search for rare causes of stroke and stroke mimics.

Age-related morphological alterations of brain vessels and parenchyma in normal and hypertensive rats

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Hypertension is a main risk factor for cerebrovascular disease in humans. To determine the factors that may participate in the development of vascular dementia (VD), we investigated the changes related to hypertension in the brain of spontaneously hypertensive rats (SHR). For this, immunohistochemistry at 2, 4 and 6 months of age was done and

compared to age-matched normotensive rats. Specific markers for brain vessels (smooth muscle actin and dysferlin), activated astrocytes (GFAP) and IgG deposits were used to identify alterations. The mean arterial blood pressure (MABP), glycaemia and body weight were measured. From the age of 2 months, SHR showed an elevated MABP compared to normotensive rats. The weight of SHR was 20% below that of normotensive rats, and their glycaemia at age 6 months was elevated. Histological results showed a thickening of the vascular walls together with depositions of IgG around them in SHR. Dysferlin-positive blood vessels, astrogliosis and enlarged ventricles were observed in this strain. We showed that physiological and morphological changes in the brain of SHR, such as blood vessel alterations, astrogliosis and atrophy, are already observed at a young age, long before any brain lesion can be seen. These modifications are similar to those observed in VD. Molecular studies are needed to understand the development of VD related to hypertension.

What factors affect early admission of acute stroke patients? Preliminary results

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Background: Despite the evidence that early admission to hospital followed by a rapid administration of thrombolytic therapy improves prognosis of acute stroke patients, only a minority of patients get to the emergency department (ED) within the accepted delay (<3 hours).

Purpose: To determine the different factors of the pre-hospital process which affect early admission.

Patients and methods: Time from onset of symptoms until arrival at the emergency department was evaluated in every stroke patient during a period of 6 months. The ability of the patients to recognise their symptoms as a stroke was also assessed.

Results: 329 patients were included in the study. The median and mean delays between onset of symptoms and time of arrival at the hospital were 3 h 20 min and 22 h 15 min respectively. When the transport was performed either by a "cardiomobile" type or by a normal ambulance, admission at the hospital was 2.4 and 1.8 times respectively quicker than the transportation done by the patient or family ($p < 0.0005$). Recognition of the symptoms as a stroke ($p < 0.0005$) and the severity (NIH >5) ($p < 0.002$) also reduced the delay. For yet undetermined reasons, the delay was increased when the patient contacted his family physician ($p < 0.004$).

Conclusions: Our results demonstrate the importance of educating the population and the different stakeholders of stroke care provision of the pre-hospital process, in order to improve the management and treatment of acute stroke patients.

Proximal protection during endovascular treatment of carotid stenosis: indication, technique, preliminary results

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Purpose: To evaluate the efficacy of proximal protection during endovascular treatment of high-grade stenosis of the internal carotid artery (ICA).

Methods: 28 patients with high-grade stenosis of the ICA were treated with stenting under proximal protection between January 2004 and November 2005. To detect procedural ischaemic lesions pre- and postprocedural diffusion-weighted MRI (DWI) was performed. In 27 cases a double balloon MOMA system was used (the proximal balloon placed in the common carotid artery and the distal balloon in the external carotid artery). In one patient with an occluded external carotid artery a new single balloon protection device was applied, which could also successfully be used for thromb aspiration with flow arrest in another case suffering from acute in-stent thrombosis (see below).

Results: The proximal protection device was easy and safe to handle. The overall occlusion time was between 5 and 6 min. The procedural mortality was zero, and we did not have any procedural-related complications.

In 4 cases massive atherosclerotic material could be aspirated which was investigated by our pathologists. Postprocedural MRI detected new DWI lesions in 5 patients and 2 patients had an acute in-stent thrombosis (one case asymptomatic under abciximab, one case with continuous growth of the thrombus under abciximab, seen in re-angiography followed by thromb aspiration).

Conclusion: Our preliminary results confirm: proximal cerebral protection is suitable, effective and safe.

Karotis-Revaskularisation im akuten Insult

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Einleitung: Wir haben uns überlegt, ob es mit Hilfe der modernen zerebrovaskulären Diagnostik gelingt, diejenigen Patienten herauszufiltern, die von einer notfallmässigen Karotis-Revaskularisation im akuten Insult profitieren.

Methodik: Es wurden alle Patienten prospektiv erfasst, die innerhalb von 72 Stunden nach Beginn eines akuten apoplektischen Insultes und innerhalb von 36 Stunden nach der stationären Aufnahme notfallmässig an der A. carotis interna (ACI) operiert wurden.

Ergebnisse: 41 Patienten (31 Männer, 10 Frauen) wurden durchschnittlich 26 (7–58) Stunden nach Symptombeginn und 18 ± 9 (3–34) Stunden nach der stationären Aufnahme notfallmässig Karotis-revaskularisiert. Alle hatten im CT/MRT Zeichen eines frischen apoplektischen Insultes. Eine präoperative Ultraschalluntersuchung erhielten

alle 41 Patienten, ein komplettes Stroke-imaging (MRT mit PWI/DWI, MRA) 32 Patienten (78%), ein cCT 9 Patienten (22%) und eine zusätzliche supraaortale DSA 22 Patienten (54%). 13 Patienten (32%) wiesen präoperativ ein Rankin-Stadium von 0 bis 2 und 28 Patienten (68%) ein Rankin-Stadium 3–5 auf. Intraoperativ fand sich in 30 Fällen (73%) ein Karotis-Verschluss und in 11 Fällen (27%) eine hochgradige embolisierende Karotis-Stenose als Ursache des Schlaganfalls. Die Karotis-Revaskularisation gelang in 26 der 30 ACI-Verschlüsse (87%) und bei allen Patienten mit einer ACI-Stenose. 25 Patienten (61%) haben sich innerhalb von 30 Tagen um mindestens 1 Rankin-Stadium verbessert, 10 Patienten (24%) sind neurologisch stabil geblieben, 3 Patienten (7,5%) haben sich neurologisch verschlechtert und 3 Patienten (7,5%) sind verstorben.

Schlussfolgerung: Durch eine sorgfältige präoperative Diagnostik können Patienten selektioniert werden, die bei überschaubarem perioperativem Risiko von einer notfallmässigen Karotis-Revaskularisation im Insult profitieren.

Diffusion-weighted imaging in stroke due to patent foramen ovale – the significance of concomitant atrial septum aneurysm

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Background and purpose: Patent foramen ovale (PFO) is an established cause of stroke in young patients without other determined aetiologies. Concomitant atrial septum aneurysm (ASA) possibly increases the risk of stroke recurrence. Advanced neuroimaging may provide insight into mechanisms and risk of cerebral embolism associated with PFO and ASA. To date, no study has compared cerebral diffusion-weighted imaging (DWI) findings between stroke patients with PFO plus ASA and those with PFO alone.

Methods: DWI and transoesophageal echocardiography findings were assessed in 48 consecutive patients with cryptogenic ischaemic stroke associated with PFO. Number and size of hyperintense lesions on DWI were correlated with PFO size, degree of interatrial right-to-left shunt (RLS) and presence of ASA.

Results: Patients with PFO plus ASA more often had multiple hyperintense DWI lesions (16/30, 53%) than those with PFO alone (3/18, 17%; $p = 0.01$). This association remained significant after correction for PFO size, degree of RLS and vascular risk factors in a logistic regression analysis ($p = 0.04$). No significant associations between DWI lesion characteristics and PFO size or degree of RLS were found.

Conclusions: The presence of concomitant ASA is independently associated with multiple cerebral ischaemic lesions in stroke due to PFO, suggesting an increased embolic risk.