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## Reports and Studies in Health Sciences

**ABDULHAMEED BAKREEN (ED.)**

# XXII Nordic Stroke Society Congress 2023

Kuopio, Finland, August 21-23  
Program and Abstracts

# **XXII Nordic Stroke Society Congress 2023**

Abdulhameed Bakreen (Ed.)

## **XXII Nordic Stroke Society Congress 2023**

**Kuopio, Finland, August 21-23**

**Program And Abstracts**

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## ABSTRACT

The XXII Nordic Stroke Society Congress 2023 is jointly organized by the University of Eastern Finland, Institute of Clinical Medicine, Neurology; Kuopio University Hospital; and the Nordic Stroke Society. The theme of the congress is the latest development in stroke care, research, and translational science presented by stroke professionals and researchers from Nordic and Baltic countries. The scientific program includes workshops, lectures, talks, and posters on recent clinical and translational/experimental advances in stroke prevention, acute management, rehabilitation, and recovery. Non-scientific perspectives from stroke patients is also included. This book compiles the program and abstracts of the XXII Nordic Stroke Society Congress 2023 held in Kuopio, Finland, August 21-23, 2023.

**Keywords:** Stroke; Brain Ischemia; Cerebral Hemorrhage; Intracranial Hemorrhages; Stroke Rehabilitation; Self-Management; Risk Factors; Stroke nursing; International Cooperation

**Avainsanat:** aivoverenkiertohäiriöt; aivoverenvuoto; kuntoutus; riskitekijät; moniammatillisuus; yhteistyö

## Welcome to XXII Nordic Stroke Society Congress 2023

Dear Colleagues,

It is with great pleasure that we welcome you to the XXII Nordic Stroke Society Congress 2023 to be held at the Kuopio City Theatre, Kuopio, Finland, on August 21-23, 2023. The congress is organized by the University of Eastern Finland, Kuopio University Hospital, and Nordic Stroke Society.

The Nordic Stroke Society was founded in 1982 and is one of the oldest societies in the field. The society promotes networking and international cooperation and makes research in the Nordic and Baltic countries more visible. An important part of the society's activities are the scientific congresses held in the different member countries every two years to present the latest research results and treatment practices for cerebrovascular disorders. The Nordic Stroke Society congress in Kuopio is the 22nd in a row and celebrates the society's 40th anniversary. The congress is organized in parallel with the 9th Kuopio Stroke Symposium.

The congress in Kuopio will provide the latest research information on prevention, acute treatment, and rehabilitation of cerebrovascular disorders. Topics include the convergence of basic and clinical research, evaluation of new risk factors, mechanical removal of cerebral artery occlusion, treatment of cerebral hemorrhages, and new technology-assisted methods of rehabilitation.

We warmly welcome you to Kuopio to enjoy science in a local "*Savo*" environment!

Pekka Jäkälä, MD, PhD  
Professor  
Chair of Local Organizing Committee

Jukka Putaala, MD, PhD, MSc  
Associate Professor/Docent  
Chair of Nordic Stroke Society

# XXII Nordic Stroke Society Congress 2023

## Organized by

University of Eastern Finland, Institute of Clinical Medicine, Neurology  
Kuopio University Hospital  
Nordic Stroke Society

## Local Organizing Committee

Pekka Jäkälä, Finland  
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# XXII Nordic Stroke Society Congress 2023

## Program and Abstracts

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# XXII Nordic Stroke Society Congress 2023

## Program in brief

Monday, August 21 | 9:00-16:00

### ***Minna hall (streaming)***

#### **Teaching course I: Endovascular thrombectomy, stents, embolization treatments**

Instructors: Petri Saari and Antti Lindgren

### ***Kuopio City Theatre***

#### **Teaching course II: Clinical Trial Workshop - How to match supply with demand**

Together with Kuopio Health

### ***Minna hall (streaming)***

#### **Opening session**

Chairs: Jukka Putaala and Pekka Jäkälä

#### **Hot topics in stroke care**

Chairs: Turgut Tatlisumak and Arne Lindgren

### ***Kuopio City Theatre***

#### **Posters**

Tuesday, August 22 | 8:30-16:20

### ***Kuopio City Theatre***

#### **Teaching course III: How to write a paper to the Stroke Journal (during lunch break)**

Instructor: Johannes Boltze

### ***Minna hall (streaming), parallel sessions I***

#### **Acute stroke management**

Chairs: Christina Kruuse and Teresa Ullberg

#### **Stroke and beyond**

Chairs: Reetta Kälviäinen and Daiva Rastenytė

#### **Stroke prevention**

Chairs: Sidsel Hastrup and Brörn Logi Þórarinsson

#### **Embolic stroke**

Chairs: Jukka Putaala and Kristaps Jurjans

***Maria hall, parallel sessions II***

**Potential and challenges of telerehabilitation**

Chairs: Sinikka Hiekkala and Iveta Haritončenko

**Short oral communications I**

Chairs: Mikko Airavaara and Anders Sode West

**Translational stroke**

Chairs: Tarja Malm and Thomas Christensen

**Short oral communications II**

Chairs: Aleksandra Ekkert and Atte Meretoja

Wednesday, August 23 | 8:30-16:40

***Minna hall (streaming), parallel sessions I***

**Therapeutic brain plasticity**

Chairs: Eero Castrén and Jukka Jolkkonen

**Advances in stroke rehabilitation**

Chairs: Guri Hagberg and Kauko Pitkänen

***Maria hall, parallel sessions II***

**Imaging**

Chairs: Ulrike Waje-Andreassen and Perttu Lindsberg

**Prognosis and outcomes in intracranial hemorrhage**

Chairs: Timo Koivisto and Ola Nilsson

***Minna hall (streaming)***

**Life after stroke**

Chairs: Mika Pyykkö and Tamar Abzhandadze

**Stroke nursing and specialized rehabilitation**

Chairs: Johanna Martin and Anne Nevakare

## Program of the XXII Nordic Stroke Society Congress 2023

### Monday, August 21

8:00- Registration

#### ***Kuopio City Theatre***

#### **Teaching course I: Endovascular thrombectomy, stents, embolization treatments**

9:00-12:00 **Hands-on neuroendovascular workshop for mechanical thrombectomy; training of clot retrieval and stenting techniques using haptic high fidelity simulators**

Petri Saari and Antti Lindgren, *Kuopio University Hospital*

#### ***Minna hall (streaming)***

#### **Teaching course II: Clinical Trial Workshop - How to match supply with demand**

*Together with Kuopio Health*

8:30-9:00 Coffee and registration

9:00-9:05 **Welcome**

Eero Rissanen, *Neurocenter Finland* and Essi Sarkkinen, *Medfiles*

9:05-9:25 **Ecosystems in clinical research**

Nadia Tamminen, *Pharma Industry Finland*

9:25-9:45 **Clinical Research is the Basis of Efficient Wellbeing Services County**

Juha Töyräs, *Wellbeing Services County of North Savo, Kuopio University Hospital*

9:45-10:00 Break

10:00-10:20 **Clinical trials in stroke: Pharma point of view**

Katharina Östberg, *Bayer*

10:20-10:40 **Clinical trials in stroke: Clinical investigator perspective**

Jukka Putaala, *Helsinki University Hospital*

10:40-11:00 **New clinical trial regulation and CTIS submission portal-Investigator, are you ready for GCP trials and new portal?**

Essi Sarkkinen, *Medfiles*

11:00-11:20 **National initiatives to enhance matchmaking in clinical trials**

Eero Rissanen, *Neurocenter Finland*

11:20-11:40 **Trial Nation - Experience from Denmark on nationally coordinated clinical trials collaboration**  
Marianne Pilgaard, *Trial Nation (online)*

11:40-12:00 Moderated panel discussion and questions from the audience

12:00-13:00 Coffee/Exhibition

### **Opening session**

Chairs: Jukka Putaala and Pekka Jäkälä

13:00-13:05 **Welcome address**  
Jukka Putaala (*Helsinki*) and Pekka Jäkälä (*Kuopio*)

13:05-13:25 **European Stroke Strategies**  
Bo Norrving (*Lund*)

13:25-13:45 **Organization of stroke services in the Baltic and Nordic countries**  
Dalius Jatužis (*Vilnius*) and Hanne Christensen (*Copenhagen*)

13:45- **Nordic Stroke Society Award winner and a Nordic Stroke Society Award lecture**  
TBA

14:30-15:00 Coffee/Exhibition

### **Hot topics in stroke care**

Chairs: Turgut Tatlisumak and Arne Lindgren

15:00-15:20 **Key updates from the recent ESO and AHA/ASA guidelines**  
Janika Kõrv (*Tartu*)

15:20-15:40 **Cerebrovascular diseases in the Covid-19 pandemic - What have we learned?**  
Katarina Jood (*Gothenburg*)

15:40-16:00 **Roadmap to enlarge the patient population who would benefit from stroke recanalization therapies**  
Daniel Strbian (*Helsinki*)

19:00-22:00 **Get-together party and posters**

**1. Pleocytosis in cerebrospinal fluid attributed to ischemic stroke: A review of the literature**  
Anders S. West (*Copenhagen*)

**2. Circadian rhythm and the influence of light on parameters related to calcium metabolism in stroke patients admitted for rehabilitation**  
Anders S. West (*Glostrup/Copenhagen*)

**3. Rehabilitation pathways after discharge from comprehensive stroke unit impact on the level of functional outcome**

Malin C. Nylén (*Gothenburg*)

**4. A short Swedish version of the Montreal Cognitive Assessment**

Tamar Abzhandadze (*Gothenburg*)

**5. Preventing falls in Neurology unit in Acute Care Hospital**

Jaana Rantama-Hiltunen (*Kuopio*)

**6. Neurologist-oriented screening of atrial fibrillation with implantable loop recorder in patients with cryptogenic stroke**

Olli P. Suomalainen (*Helsinki*)

**7. Virtual Motor Spaces: Exploring how to amplify movements in virtual reality stroke rehabilitation to aid patients with upper limb hemiparesis**

Iris Brunner (*Aarhus*)

**8. Posterior circulation stroke patients - why don't they get reperfusion therapy?**

Aleksandra Ekkert (*Vilnius*)

**9. Sex-related differences in baseline characteristics and risk factors in young-onset cryptogenic ischemic stroke**

Nicolas Martinez-Majander (*Helsinki*)

**10. Transportation directly to the comprehensive stroke center could provide time-benefit to patients with large vessel occlusion**

Tuuli Miettinen (*Kuopio*)

**11. Transient ischemic attack - a warning sign of ischemic stroke**

Tiina Komulainen (*Kuopio*)

**12. Initiation of antipsychotics and ischemic stroke in young adults**

Jenna Broman (*Helsinki*)

**13. Predicting post stroke cognitive impairment**

Katrine Zachariassen (*Aarhus*)

**14. Diet-induced weight loss in obese/diabetic mice normalizes glucose metabolism and promotes functional recovery after stroke**

Dimitra Karampatsi (*Stockholm*)

**15. Nanoencapsulated neuroglobin activates neurogenesis after ischemic stroke**

Ángela Naranjo (*Jaén*)

**16. Modulating microglia phagocytosis after stroke**Helike Löhelaid (*Helsinki*)**17. Multidimensional magnetic resonance imaging in the evaluation of a novel neuroglobin treatment for ischemic stroke**Sara Gröhn (*Kuopio*)**18. Combined adipose tissue-derived mesenchymal stem cell therapy and rehabilitation for brain repair and functional recovery after stroke**Abdulhameed Bakreen (*Kuopio*)**Tuesday, August 22**

8:00- Registration

***Minna hall (streaming), parallel session I*****Acute stroke management**

Chairs: Christina Kruuse and Teresa Ullberg

8:30-8:50 **Optimizing prehospital transportation**Anne-Mari Kantanen (*Kuopio*)8:50-9:10 **Current status of tenecteplase in stroke thrombolysis**Vojtech Novotny (*Bergen*)9:10-9:30 **Wake-up stroke: Characteristics and treatment options**Ellisiv Mathiesen (*Tromsø*)9:30-9:50 **Management of blood pressure in acute stroke**Iveta Haritončenko (*Riga*)***Maria hall, parallel session II*****Potential and challenges of telerehabilitation**

Chairs: Sinikka Hiekkala and Iveta Haritončenko

8:30-8:50 **Rehabilitation technologies from the laboratory to the clinic and to home**Erika G. Spaich (*Gistrup, Denmark*)8:50-9:10 **VR for upper limb motor function and neglect**Iris Brunner (*Aarhus*)9:10-9:30 **Telerehabilitation in post-stroke aphasia**Hege Prag Øra (*Nesoddtangen*)9:30-9:50 **Telerehabilitation services for stroke**Kate Laver (*Adelaine, Australia, online*)

10:00-10:30 Coffee/Exhibition

***Minna hall (streaming), parallel session I***

**Stroke and beyond**

Chairs: Reetta Kälviäinen and Daiva Rastenytė

10:30-10:50 **Stroke and Pregnancy Lecture**

Karoliina Aarnio (*Helsinki*)

10:50-11:10 **Shared and distinct mechanisms of stroke and migraine**

Rashid Giniatullin (*Kuopio*)

11:10-11:30 **Stroke and Epilepsy**

Reetta Kälviäinen (*Kuopio*)

11:30-11:50 **The myriad of medical and neurovascular conditions underlying non-traumatic intracerebral hemorrhage in young adults**

Turgut Tatlisumak (*Gothenburg*)

***Maria hall, parallel session II***

**Short oral communications I**

Chairs: Mikko Airavaara and Anders Sode West (10 min including 1-2 min discussion)

10:30-10:40 **Cocaine-induced spinal cord transient ischemic attack: Case report**

Triin Helin Unt (*Tartu*)

10:40-10:50 **Hemorrhagic stroke among octogenarians with atrial fibrillation: 30-day case fatality, prior oral anticoagulation, and time trends over ten years**

Paula Tiili (*Helsinki*)

10:50-11:00 **Traffic accidents among motor vehicle drivers with stroke - a national Swedish cohort study**

Hanna C. Persson (*Gothenburg*)

11:00-11:10 **Healthcare professionals addressing post-stroke sexual rehabilitation - A Systematic Review**

Katrine Vollbrecht Amdi (*Copenhagen*)

11:10-11:20 **Stenting of intracranial stenosis with the fibrin-heparin coated Credo Heal stent - Multicenter experience**

Hannes Nordmeyer (*Solingen*)

11:20-11:30 **20-year mortality after early-onset ischemic stroke: the Helsinki young stroke registry**

Nicolas Martinez-Majander (*Helsinki*)



- 11:30-11:40 **Anti-beta-2-glycoprotein I and anti-cardiolipin antibodies are associated with early-onset cryptogenic ischemic stroke**  
Nina Jaakonmäki (*Helsinki*)
- 11:40-11:50 **Early and late mortality and causes of death after cerebral venous thrombosis**  
Elisa Häppölä (*Helsinki*)
- 12:00-13:00 Lunch/Exhibition/Industry session/**Teaching course III: How to write a paper to the Stroke Journal** - Johannes Boltze (*Warwick*)

***Minna hall (streaming), parallel session I***

**Stroke prevention**

Chairs: Sidsel Hastrup and Brörn Logi Þórarinsson

- 13:00-13:20 **Nationwide primary stroke prevention programs**  
Atte Meretoja (*Helsinki*)
- 13:20-13:40 **Are new anti-diabetics good for stroke prevention?**  
Thomas Truelsen (*Copenhagen*)
- 13:40-14:00 **New insights into lipid lowering medication in stroke prevention**  
Petra Ijäs (*Helsinki*)
- 14:00-14:20 **Adherence to secondary prevention medications after stroke - Can we do better?**  
Riina Vibo (*Tartu*)

***Maria hall, parallel session II***

**Translational stroke**

Chairs: Tarja Malm and Thomas Christensen

- 13:00-13:20 **Improving translational research**  
Johannes Boltze (*Warwick*)
- 13:20-13:40 **Advances in stroke biomarker discovery**  
Tarja Malm (*Kuopio*)
- 13:40-14:00 **Preclinical strategies to improve stroke recovery in diabetes**  
Cesare Patrone (*Stockholm*)
- 14:00-14:20 **ER resident protein MANF with neurorestorative and immunomodulatory effects**  
Mikko Airavaara (*Helsinki*)
- 14:30-15:00 Coffee/Exhibition

**Minna hall (streaming), parallel session I****Embolic stroke**

Chairs: Jukka Putaala and Kristaps Jurjans

- 15:00-15:20 **Cryptogenic stroke - matter of heart and age**  
Nicolas Martinez-Majander (*Helsinki*)
- 15:20-15:40 **Advanced imaging in identifying cardioembolic sources**  
Marja Hedman (*Kuopio*)
- 15:40-16:00 **When to start oral anticoagulants after acute ischemic stroke in patients with atrial fibrillation?**  
Per Wester (*Stockholm/Umeå*)
- 16:00-16:20 **Current status of left atrial appendage closure in stroke prevention among patients with atrial fibrillation**  
Dorte Damgaard (*Aarhus*)

**Maria hall, parallel session II****Short oral communications II**

Chairs: Aleksandra Ekkert and Atte Meretoja (10 min including 1-2 min discussion)

- 15:00-15:10 **Stroke, myocardial infarction and mortality in type 2 diabetes: A nationwide comparative effectiveness study of GLP-1RA, SGLT2i and DPP-4i treatment**  
Sidsel Hastrup (*Aarhus*)
- 15:10-15:20 **Self-perceived stress is associated with both non-dipping blood pressure and cryptogenic ischemic stroke in young adults**  
Lauri Tulkki (*Helsinki*)
- 15:20-15:30 **Mental health and returning to work after stroke among young stroke patients in Tartu, Estonia**  
Minni Saapar (*Tartu*)
- 15:30-15:40 **May prenotification of FAST symptoms increase activation of stroke alert and shorten prehospital time - retrospective cohort study**  
Ida Bakke (*Tromsø*)
- 15:40-15:50 **Recanalization therapies for acute ischemic stroke in 2 largest hospitals in Estonia: why the differences?**  
Teele Tuularu (*Tartu, Tallinn*)
- 15:50-16:00 **Sex differences in the outcomes after mechanical thrombectomy and thrombolysis - Meta-analysis by the Stroke in Women Guideline Module**  
Christine Kremer (*Malmö*)

16:00-16:10 **Xanthine oxidase inhibition and white matter hyperintensity progression following ischaemic stroke and transient ischaemic attack in people with elevated serum uric acid levels**

Rida Hamandi (*Malmö*)

16:10-16:20 **Optimizing the density and locations of thrombectomy centers and HEMS helicopters in regard to the cost-effectiveness of endovascular treatment modalities**

Nicklas Ennab Vogel (*Linköping*)

16:45- **Nordic Stroke Society General Assembly**

19:00-22:00 **Banquet dinner**

### **Wednesday, August 23**

8:00- Registration

#### ***Minna hall (streaming), parallel session I***

#### **Therapeutic brain plasticity**

Chairs: Eero Castrén and Jukka Jolkkonen

8:30-8:50 **Adaptive brain plasticity after stroke - Evidence from preclinical models**

Karsten Ruscher (*Lund*)

8:50-9:10 **Pharmacological promotion of neuronal plasticity**

Eero Castrén (*Helsinki*)

9:10-9:30 **Fluoxetine cons**

Katharina Stibrant Sunnerhagen (*Gothenburg*)

9:30-9:50 **Therapeutic brain plasticity: future perspectives**

Andrew Clarkson (*Dunedin, New Zealand, online*)

9:50-10:00 **Awards - best poster and short oral communication**

#### ***Maria hall, parallel session II***

#### **Imaging**

Chairs: Ulrike Waje-Andreassen and Perttu Lindsberg

8:30-8:50 **Ancillary imaging to guide recanalization therapies of acute ischemic stroke - harm or benefit?**

Sami Curtze (*Helsinki*)

8:50-9:10 **Contribution of ultrasound examinations in the etiologic evaluation of patients with ischemic stroke/TIA**

Ulrike Waje-Andreassen (*Bergen*)

9:10-9:30 **Imaging of intracerebral hemorrhage**

Michaela Bode (*Oulu*)

9:30-9:50 **Neuroimaging patterns associated with clinical outcomes**

Arne Lindgren (*Lund*)

10:00-10:30 Coffee/Exhibition

### ***Minna hall (streaming), parallel session I***

#### **Advances in stroke rehabilitation**

Chairs: Guri Hagberg and Kauko Pitkänen

10:30-10:50 **Intelligent technology to enable decentralized neurorehabilitation**

Olivier Lambercy (*Zurich*)

10:50-11:10 **Standardized measurement of upper limb recovery after stroke - recommendations and implementation**

Margit Alt Murphy (*Gothenburg*)

11:10-11:30 **Assessment instruments for evaluation of stroke outcomes**

Terry Quinn (*Glasgow*)

11:30-11:50 **Smart garment and immersive exergaming to enhance feedback of upper limb training**

Timo Siponen (*Helsinki*)

### ***Maria hall, parallel session II***

#### **Prognosis and outcomes in intracranial hemorrhage**

Chairs: Timo Koivisto and Ola Nilsson

10:30-10:50 **The results of surgical evacuation of ICH as evaluated by novel biomarkers**

Juhana Frösen (*Tampere*)

10:50-11:10 **Long-term prognosis of intracerebral hemorrhage**

Sami Tetri (*Oulu*)

11:10-11:30 **Prognosis of poor grade aneurysmal subarachnoid hemorrhage**

Olli Kämäräinen (*Kuopio*)

11:30-11:50 **Functional outcome of aneurysmal subarachnoid hemorrhage**

Angelika Sorteberg (*Oslo*)

12:00-13:00 Lunch/Exhibition/Industry session

**Minna hall (streaming)**

**Life after stroke**

Chairs: Mika Pyykkö and Tamara Abzhandadze

13:00-13:20 **Caregivers' situation after stroke**

Susanne Guidetti (*Stockholm*)

13:20-13:40 **Mind the patient perspective!**

Kaj Kunnas (*Nykarleby*)

13:40-14:00 **Tools to support follow-up**

Emma Kjörk (*Gothenburg*)

14:00-14:20 **The Finnish Brain Association: Patient Organisation Perspective**

Mika Pyykkö (*Turku*)

14:30-15:00 Coffee/Exhibition

**Stroke nursing and specialized rehabilitation**

Chairs: Johanna Martin and Anne Nevakare

15:00-15:20 **Tools to talk - a reimplementation study of supported conversation for adults with aphasia**

Mia Loft (*Copenhagen*)

15:20-15:40 **Organizational conditions as barriers to person-centered nursing and professional care: A qualitative interview study of nurses' experiences of pain in patients admitted with stroke**

Maria Brudsø (*Copenhagen*)

15:40-16:00 **ESO Quality in Acute Stroke Care (QASC) project**

Anneli Jaska (*Tartu*)

16:00-16:20 **Implementing dysphagia screening for acute-stroke patients**

Johanna Martin (*Helsinki*)

16:20-16:40 **Spatial neglect and related disorders in acute stroke care - new screening procedures for bedside use**

Marianne Elisabeth Klinke (*Reykjavik*)

## **Abstracts for Invited Talks**

(in descending order of arrangement in the program)

## **European Stroke Strategies**

Bo Norrving

*Dept of Clinical Sciences/Neurology, Lund University, Sweden*

Two pan-European consensus conferences on stroke were held in 1995 and 2006, resulting in the Helsingborg declarations which included setting of targets within a 10 years' period. In 2018, the European Stroke Organisation (ESO), in cooperation with the Stroke Alliance for Europe (SAFE), launched the Stroke Action Plan for Europe (SAP-E) 2018-2030 published in European Stroke Journal. The SAP-E included domains on primary prevention and life after stroke, as well as the domains on stroke services that were part of the Helsingborg declarations. Four overarching targets were set including reduction in number of strokes, promotion of stroke unit care, national stroke plans, and multisectorial public health interventions. An implementation steering committee appointed by the (ESO) has been in place since 2019, with a focus on establishing a strategy framework, define Key Performance Indicators (KPI) for monitoring the quality of care and reaching the targets, and set up a dissemination strategy. The SAP-E aims to establish close connections with the WHO, the WSO, the AHA/ASA, other existing European initiatives, national stroke societies, national stroke support organisations, and national government agencies. The national scientific societies as well as national stroke support organisations are the key- players looking at an individual country level, as they have the insights into actual status of care as well as knowledge on lines of decision, and are in direct contact with the national Ministries of Health, which are important partners in implementing SAP-E. So far, over 90 national coordinators have been appointed and 49 countries in the WHO European region are involved in the program. A roll-out plan for engaging Ministries of Health in all European countries has been prepared through a SAP-E declaration. So far, 12 countries (Ukraine, Lithuania, Spain, Kosovo, Portugal, Bulgaria, Catalonia, Slovakia, Romania, Estonia, North Macedonia, Croatia) have signed the SAP-E Declaration. Twelve KPIs have been defined. These are monitored on an annual basis through a public Stroke Service Tracker displaying aggregated national data. The SAP-E is the largest stroke project ever undertaken in Europe, and has the potential to substantially prevent many strokes and improve stroke services. The strategic structure of the SAP-E may serve as a model for other regional stroke plans. This presentation will present an update of the current status of ongoing strategic stroke activities in Europe, with a focus on the SAP-E.

**Organization of stroke services in the Baltic and Nordic countries**

Dalius Jatužis<sup>1</sup> and Hanne Christensen<sup>2</sup>

*<sup>1</sup>Vilnius University Faculty of Medicine, Lithuania; <sup>2</sup>Copenhagen University Hospital, Bispebjerg, Denmark*

Organisation of stroke services remains a prerequisite to high quality stroke care. Organisation must cover the entire chain of care from the pre-hospital phase to life after stroke and be robust. National registries with mandatory reporting and auditing are needed for quality and outcome control. In this talk, the organization of stroke care in the Nordic and Baltic countries will be described and compared.



## **Key updates from the recent ESO and AHA/ASA guidelines**

Janika Kõrv

*Department of Neurology and Neurosurgery, University of Tartu, Estonia*

Clinical guidelines are essential tools to improve the quality of stroke care. The largest organisations providing guidelines for stroke management are the European Stroke Organisation (ESO) and the American Heart Association/American Stroke Association (AHA/ASA). The ESO guidelines are based on the method which was developed by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group. Since 2013 there are 49 published guidelines covering important aspects in stroke care and 12 guidelines are currently in development. The recent key update in the treatment of acute ischemic stroke (AIS) is the recommendation to perform recanalization therapy within the extended time window until the first 24 hours from stroke onset. The ESO expedited recommendation is initiated in instances where there is at least one published guideline-changing randomized controlled trial (RCT). In 2022, the expedited recommendation on indication for intravenous thrombolysis (IVT) before mechanical thrombectomy in patients with AIS and anterior circulation large vessel occlusion was published. The latest update is the ESO expedited recommendation on tenecteplase for AIS, where the working group gave a strong recommendation to use tenecteplase 0.25mg/kg as a safe and effective alternative to alteplase, and for patients with large vessel occlusion of <4.5 h duration who are eligible for IVT to use tenecteplase 0.25 mg/kg over alteplase 0.9 mg/kg, both recommendations based on moderate evidence. The American Heart Association (AHA)/American Stroke Association (ASA) focuses mainly on medical practice in the United States. Since 2017 the AHA/ASA guidelines have been shortened and made more user friendly. The recommendations are designated with both a class of recommendation (COR) which shows the strength of recommendation and level of evidence (LOE) which shows the quality of scientific evidence. The latest AHA/ASA recommendation is the guideline for the management of patients with aneurysmal subarachnoid haemorrhage published in 2023. The recent guidelines include the updates for management of patients with spontaneous intracerebral haemorrhage (2022), prevention of stroke in patients with stroke and transient ischemic attack (2021), and early management of patients with AIS (2019). Expedited recommendations from both organisations are highly expected as the results from several recent completed RCTs, including minimally invasive surgery for intracerebral haemorrhage and timing of start of oral anticoagulants in persons with atrial fibrillation who have had an AIS may improve everyday clinical practice and thereby improve the outcome of stroke.

## **Cerebrovascular Diseases in the COVID-19 Pandemic - What Have We Learned?**

Katarina Jood

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The COVID-19 pandemic caused significant changes in the health care systems worldwide, as resources were directed towards acute in-hospital care of critically ill COVID-19 patients. Given reports of several neurologic manifestations in association with COVID-19, including ischemic, hemorrhagic and cerebral venous stroke, in the early phase of the pandemic, the incidence of stroke was predicted to increase. Paradoxically, a significant global decline in the volume of both ischemic and hemorrhagic stroke admissions to hospitals was observed during the first year of the pandemic. This decline was more pronounced in the early phase of the pandemic, in primary compared to comprehensive stroke centers, and not solely confined to centers with high COVID-19 volumes. Additionally, studies reported decline in numbers of transfers to in-patient rehabilitation facilities, volumes of patients receiving intravenous thrombolysis, and consultations related to cerebrovascular conditions in primary care. In contrast, volumes of thrombectomy and admissions for cerebral venous thrombosis remained largely unchanged during the pandemic. Compared to pre-pandemic controls, stroke patients admitted to hospitals during the pandemic were younger, more frequently male, had higher baseline NIHSS scores, higher probability for large vessel occlusion, for receiving thrombectomy, and higher risk for in-hospital mortality. Various factors have been suggested to explain the observed changes, including altered patient behavior and clinical decision-making resulting in reduced presentations and admissions of TIAs and mild strokes. A true reduction in stroke incidence has also been suggested, potentially attributed to improved population-level control of environmental vascular risk factors, reduction of planned procedures conferred with stroke risk and reduced exposure to other viruses known to trigger vascular events. The reported risk of stroke in COVID-19 have varied across studies, with one meta-analysis estimating a risk of around 2%, which is substantially lower compared to early reports. Reports indicate that patients with acute ischemic stroke and COVID-19 have higher baseline NIHSS scores, lower rates of successful recanalization, higher risk of intracranial bleeding after revascularization treatment, and worse clinical outcomes. Potential mechanisms include systemic inflammation, hypercoagulability, endothelial and cardiac injury. In summary, the COVID-19 pandemic had significant global impact on stroke care at all levels, including altered reporting of cerebrovascular events, and change of patient behavior. The care for more severe stroke cases appeared to be less affected.

**Roadmap to enlarge the patient population who would benefit from stroke recanalization therapies**

Daniel Strbian

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## **Optimizing prehospital transportation**

Anne-Mari Kantanen

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Optimizing prehospital transportation is needed to ensure the fastest possible stroke-imaging and evaluation of the patient for acute stroke treatments: intravenous thrombolysis (IVT) and mechanical thrombectomy (MET). These treatments should be started within the shortest possible delay from the symptom onset to ensure best possible outcome on the patients. Every country and regional area responsible for stroke treatment should have a comprehensive stroke protocol and multidisciplinary team ensuring its implementation, training and update. Protocols should be evaluated annually. Data on delays and outcome should be analyzed via treatment registries. Teamwork and collaboration with emergency medical services, emergency departments, acute neurology, radiology and an intervention team as well as primary and comprehensive stroke centers in the area should be of interest.

### **1. Education, dispatch code and protocol for transportation**

Most important pre-hospital optimizing issues are: education (general public and health care professionals), emergency medical services special dispatch code for stroke, written and trained protocol for stroke patient transportation and practiced prenotification protocol for hospitals.

### **2. Need for assessment and destination protocol**

Good transportation protocol includes destination protocol with prehospital assessment tools for determining the probability of large vessel occlusion and protocols leaning on the current distance from the primary and comprehensive stroke centers and telestroke facilities. Protocol takes into consideration regional hospital network, capacity of stroke units and hospitals beds as well as challenges of the local terrain, weather, population and the means of transportation available.

### **3. Continuous teamwork**

Optimizing prehospital stroke transportation is comprehensive teamwork and requires well-defined regional and national protocols focusing on early recognition and the best use of local emergency medical and hospital resources. Protocols need to be trained and updated continuously.

## **Current status of tenecteplase in stroke thrombolysis**

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In recent years, there has been an increasing research interest in tenecteplase as a mean of intravenous thrombolysis in acute ischemic stroke treatment. Both the practical convenience of a single bolus administration as well as biochemical supremacy over alteplase make tenecteplase an attractive thrombolytic. We present an overview of the evidence-based data regarding tenecteplase in acute ischemic stroke treatment. The dosage, efficacy, and safety are discussed based on the data from the completed phase two & phase three trials as well as the recommendations by the European Stroke Organization (ESO). Unanswered questions regarding important aspects and subgroups lacking evidence are discussed, pointing out the major ongoing and upcoming phase three trials that may fill the gaps in the current knowledge. The 0.25 mg/kg tenecteplase may be used as a safe and effective alternative to standard dose alteplase in acute ischemic stroke <4.5 hours. The same evidence applies to patients with large vessel occlusion in the same timeframe. Based on the NOR-TEST trials, the 0.4 mg/kg tenecteplase is nowadays not recommended for acute ischemic stroke. There is uncertainty regarding patients with acute ischemic stroke on awakening or with acute ischemic stroke of unknown onset. New data on acute ischemic stroke in the late window seem promising and phase three trials addressing this issue are awaited to be presented soon. Tenecteplase 0.25mg/kg may be used as an alternative thrombolytic to standard dose alteplase in a considerable stroke population. New data coming in the following years may shed light on remaining stroke subgroups.

**Wake-up stroke: Characteristics and treatment options**

Ellisiv Mathiesen

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## **Management of blood pressure in acute stroke**

Iveta Haritončenko

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Ischemic stroke is one of the most impacting diseases in the world. Furthermore, hypertension is the most important modifiable risk factor for stroke. Chronic untreated hypertension is associated with cardiovascular hypertrophy and increased sympathetic activity, which might cause cerebral autoregulation impairment. Due to an acute stroke, arterial blood pressure is usually elevated. The blood pressure target may differ based on the acute or chronic stage, comorbidities, clinical situations, and stroke treatment strategies. For patients not treated with intravenous t-PA, the optimal blood pressure target has not yet been determined. In patients with  $\geq 220/120$  mmHg, reducing blood pressure should be individualized, although, it is generally considered safe and reasonable to lower blood pressure by 15 % from baseline. Otherwise, according to the current AHA and ESO guidelines, before intravenous tPA can be administered, blood pressure of  $< 185/110$  mmHg is required and should be stabilized and maintained at or below blood pressure  $< 180/105$  mmHg for at least 24 hours after thrombolytic treatment. The choice of antihypertensive agent for lowering blood pressure depends on the history of hypertension, individualized drug regimens, patient comorbidities, and pharmacological class. Treatment with a thiazide diuretic, angiotensin-converting enzyme inhibitor, or angiotensin II receptor blocker is useful for lowering blood pressure, and it might be difficult to find the best treatment available to reduce the risk of recurrent stroke, sometimes required with medication combinations.

## Rehabilitation technologies from the laboratory to the clinic and to home

Erika G. Spaich

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Developing rehabilitation technologies based on neurophysiological principles, that meet the needs of the end-users, and that can be successfully implemented is not a trivial endeavor. In a user-centered design approach, patients and healthcare professionals are involved in the design and development process with the purpose of achieving meaningful solutions [1], which is of paramount importance when developing complex, patient-tailored health technologies. An exemplary case of co-developing a sound-feedback technology for the rehabilitation of movement disorders is presented. An iterative design and development process was used, where several cycles of iteration were performed. The cycles included a) informing the functional specifications by therapists, b) prototype development by engineers, c) formative evaluation by therapists, d) analysis of results by engineers, e) further prototype development, f) formative evaluation by patients and therapists, and g) analysis of results by engineers. The technical development was based on a framework built to facilitate sound-feedback research in poststroke movement rehabilitation [2]. The formative evaluation by therapists revealed e.g., issues with the complexity of the feedback strategies and the characteristics of some sounds, and the potential of the technology to be used by patients alone [3]. A feasibility study involving patients and physiotherapists explored aspects of user experience and documented suggestions for further development [3]. In the next cycle, the focus was to develop the laboratory-based research framework into a portable system for the therapists as end-users, including an interface based on a simple mobile App. After the clinical evaluation of the system, a further cycle of development will follow, should the patients also be end-users. Although apparently complex, this design approach increases the likelihood of developing a rehabilitation technology that is efficient and effective.

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**VR for upper limb motor function and neglect**

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XR (Extended Reality) applications, including VR (Virtual Reality), MR (Mixed Reality), and AR (Augmented Reality) offer unique possibilities for precise assessment, monitoring of improvement, and individually tailored treatment. However, the application of XR in rehabilitation settings is still limited, fragmented, and frequently lacks a rationale. In this talk, relevant features of XR-supported upper limb rehabilitation from our own and other research will be presented. Special challenges and opportunities for XR applications in the subacute phase will be discussed including intensity of training, self-training, and telerehabilitation. Furthermore, pilot data from a VR whack-a-mole game which combines training for unilateral spatial neglect and upper limb motor training will be presented. This VR game has integrated several evidence-based therapeutical approaches such as mirror therapy and prismatic adaption and provides different motor spaces for patients with impaired upper limb function. Challenges and opportunities related to combining motor and cognitive training will be debated and user experiences reported. Future directions of XR neurorehabilitation will be discussed.

## **Telerehabilitation in post-stroke aphasia**

Hege Prag Øra

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**Background:** Intensity of speech-language therapy for post-stroke aphasia is a key predictor for outcome. Current aphasia services may not provide therapy at sufficient intensity due to resource limitations. Telerehabilitation could widen access to speech-language therapists in geographically remote contexts and overcome barriers to clinic attendance. Evidence to its support is however still scarce, with the need for larger trials. In our study, we investigated the use of speech-language therapy by videoconference in post-stroke aphasia with regards to technical features, feasibility, acceptability and effects on language outcomes.

**Methods:** In a pilot randomized controlled trial, sixty-two participants with post-stroke aphasia were allocated to receive five hours of speech-language therapy by videoconference per week over four consecutive weeks together with usual care (n=32), or usual care alone (n=30). The telerehabilitation was tailored to language impairment, focusing on expressive language, everyday communication and naming. The technical setup, satisfaction with therapy, data safety and privacy were evaluated. Participants were assessed blindly at baseline, four-weeks, and four-months with the subtests naming, repetition and comprehension from Norwegian Basic Aphasia Assessment, the subtest sentence production from Verb and Sentence Test and the Communicative Effectiveness Index.

**Results:** Over a two-year intervention period, 556.5 hours of speech-language therapy by videoconference were delivered. The technical fault rate was tolerable with 86 faults over 541 video sessions. Overall satisfaction with telerehabilitation was rated high by 93% of the participants and two of three speech-language therapists. There were no significant between-group differences in naming or auditory comprehension. However, from baseline to four-months follow up, repetition scores ( $p=0.026$ ) and VAST scores ( $p=0.002$ ) increased significantly larger in the telerehabilitation group compared to the control group. The CETI scores were without significant between group differences.

**Conclusions:** The telerehabilitation intervention was found feasible, acceptable with tolerable technical fault rates and high satisfaction. Speech-language therapy by videoconference in addition to usual care may improve repetition and sentence production, and is considered to be a sustainable service model in post-stroke aphasia. Our model is ready to be applied in a larger scale across a range of clinical contexts.

**Telerehabilitation services for stroke**

Kate Laver

*Flinders University, Adelaide, Australia*

Telerehabilitation is becoming more established as a method of service delivery which can be used to assist in assessment, delivery of rehabilitation therapies and support following discharge from hospital or inpatient rehabilitation. In the past few years, innovative models of care have been trialed using telehealth for people with stroke. This includes coaching, avatar use to facilitate engagement, transition support after a hospital stay, combining telehealth with other technologies such as wearable sensors and family involvement in care. Current evidence suggests that telerehabilitation is not inferior to in person therapy although more evidence is required.

## **Stroke and Pregnancy Lecture**

Karoliina Aarnio

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Stroke during pregnancy and puerperium is a potentially devastating event for both the mother and the child. Luckily, it is a relatively rare event, as ischemic and hemorrhagic strokes occur in around 12 per 100 000 pregnancies, and cerebral venous sinus thromboses in around 9 per 100 000 pregnancies. However, studies suggest an increasing incidence of pregnancy-associated stroke within the last years and decades, the cause of which is still not fully known, but may be attributable to increasing incidence of stroke-related risk factors, ageing mothers, and rising incidence of young stroke in general. In normal pregnancy, there are several physiological changes contributing to a more prothrombotic state, but also there are cardiac changes and venous stasis caused by the growing uterus. The risk of stroke is usually highest within peripartum and in the early postpartum period. There are several pregnancy- and puerperium-specific risk factors, especially pre-eclampsia and other hypertensive disorders of pregnancy, but also traditional stroke risk factors, such as smoking, alcohol and substance abuse as well as chronic hypertension, play a role. Pregnancy-related hypertension is the most important risk factor for both hemorrhagic and ischemic stroke in pregnancy and puerperium. Also, complications in pregnancy, such as pre-eclampsia, gestational diabetes and pregnancy-induced hypertension are associated with an increased risk of stroke later in life, even without pregnancy-associated stroke. In general, the management of acute ischemic stroke in pregnancy and puerperium should follow routine management protocols, with intravenous thrombolysis as well as mechanical thrombectomy both possible in disabling stroke, when benefits outweigh the risks, and preferably with decision-making made in a multidisciplinary team. Women who have suffered a stroke in pregnancy or puerperium, have fewer future pregnancies than control women of similar age. In future pregnancies, hypertensive disorders of pregnancy and any diabetes during pregnancy are more common after previous stroke during pregnancy or puerperium. Pregnancy-associated stroke might happen again, as one study reported recurrence in 5.5% of patients. Still, there is no need to usually withhold future pregnancies, but optimizing the care of vascular risk factors and possible pregnancy complications is essential in preventing future strokes. The secondary preventive medications should be adjusted so that they are suitable to use in pregnancy and during lactation.

**Shared and distinct mechanisms of stroke and migraine**

Rashid Giniatullin

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Migraine and stroke are common and costly neurological disorders with bidirectional comorbidity. The most obvious relationship is between stroke and migraine with aura, as they are both associated with the development of a spreading depolarization in the brain. Headache, the hallmark of migraine, is also present in stroke patients and is often underestimated. The cellular and molecular mechanisms of migraine pain originating from the trigeminal innervation of the meninges are just beginning to be established. Progress in this area has been accelerated by the recent invention of the immunotherapy for the treatment of migraine based on monoclonal antibodies against the neuropeptide CGRP. In contrast to migraine, there is almost nothing known about the mechanisms of headache in stroke. In my report, I will present the latest data on the role of chemical and mechanical factors and mechanisms that trigger nociceptive signaling in the meninges, and the first attempts to establish pain mechanisms in stroke models. I will also discuss a possible neuroprotective role of CGRP in stroke in the context of the potential side effects of rapidly expanding new monoclonal antibody treatments for migraine patients.

## **Stroke and Epilepsy**

Professor Reetta Kälviäinen

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Post-stroke epilepsy (PSE), defined as the occurrence of one or more unprovoked epileptic seizures at least seven days after stroke onset, is an impactful consequence of stroke. It develops in at least 4–6% of patients with stroke and accounts for 50% of all cases of newly diagnosed epilepsy among people aged 60 years and older. Although PSE generally has a good response to antiseizure medicines (ASMs), around 20% of the subjects are drug-resistant. Alterations in the properties of neurotransmitter receptors and ion channels, overexpression of efflux transporters and sprouting of synaptic connections occur at brain level in response to acute vascular injuries. These adaptations are key determinants of the recovery from cerebral damage and they can also result in aberrant plasticity, contribute to the hyper-synchronization of neuronal circuits and lead to the development of epilepsy. The entity of the injury and the presence of blood derivatives in the brain can act as crucial modifiers of these reactive changes and enhance those maladaptive responses that ultimately contribute to drug resistance. These events may contribute to explaining the higher probability of pharmaco-resistance in people with severe stroke and intracerebral hemorrhage. Stroke severity, younger age, hemorrhagic subtype of stroke, and alcohol use have been identified as risk factors for the development of stroke-related epilepsy. The findings of meta-analyses suggest that about one in 15 ischemic stroke patients treated with IVT, mechanical thrombectomy, or both develop seizures independently of the specific reperfusion treatment that they received. Scoring systems are available to estimate the risk of epilepsy after stroke, such as the SeLECT and CAVE scores. Only a few studies have used multivariable models to predict drug-resistant PSE. Younger age at stroke onset is linked with a higher probability of drug-resistant PSE, and older age acts as a protective factor. The time from stroke to PSE is inversely associated with the likelihood of pharmaco-resistance, with a shorter latency being related to a higher risk of uncontrolled epilepsy. There is currently no evidence to support the use of ASMs to prevent unprovoked seizures following stroke. PSE is treated with long-term ASM treatment with drugs effective for focal seizures.

## **The myriad of medical and neurovascular conditions underlying non-traumatic intracerebral hemorrhage (ICH) in young adults**

Turgut Tatlisumak

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Non-traumatic intracerebral hemorrhage (ICH) is an uncommon but serious disease among young adults (aged 18-50 years) with an estimated annual incidence of ~5/100 000 persons/year. Most data come from single-center and retrospective studies with various settings. Frequency increases with aging, and 2/3 of the patients are male. Vascular risk factors appear to be fairly common among these patients. The causes are manifold: in Asian patient series hypertension is the most common cause whereas European and North American series structural causes (such as AV-malformations, cavernoma, and aneurysms) and hypertension being both leading causes. Anticoagulation and cerebral amyloid angiopathy are rare in this age group. Amphetamines and cocaine are the most frequently reported illicit drugs behind ICH in the young. The cause remains undetermined even after adequate investigations in 1/5 of the patients. Acute treatment includes supportive care, lowering high blood pressures, and if possible, eradication of underlying cause. Hematoma evacuation may lower mortality, but evidence is not robust. Regarding outcomes and long-term consequences: 3-month mortality is 17%, 10-year mortality >25%, 10-year recurrence risk >10%, 10-year post-ICH epilepsy risk is >25%, 10-year functional outcome among survivors showed ~25% remained disabled (mRS 3-5), only half of the survivors could return to work. Further, high rates of depression (1/4 of patients), anxiety (40%), fatigue (half of patients), and pain (half of patients) were reported. High recurrence rates indicate that aggressive search to identify the treatable underlying cause(s) and risk factors and treating them are of utmost importance.

## **Nationwide primary stroke prevention programs**

Atte Meretoja

*Helsinki University Hospital, Finland*

With the median age of a stroke patient at >75 years, the stroke patients of year 2100 are born to-day. The lifetime vascular risk burden of these children is determined largely by habits around diet, physical exercise, and vices such as tobacco and alcohol, usually established and set in the early years of life. Societies aim to guide such choices and influence the occupational and environmental factors playing a role in the risk spectrum. Medical therapies may alleviate some accumulated metabolic risks further down the track, but only to a small extent. Still, Nordic populations have lived healthier lives and stroke risk factor control has improved correspondingly over the years. As a result, age-adjusted stroke incidence has been declining in some countries by around 2% annually, resulting in fewer strokes despite aging populations. There are indications such trends may have plateaued and might reverse. While smoking cessation and blood pressure control continue to enjoy improving trends, obesity and hyperglycaemia have increased in the population, and occupational physical exercise is becoming rarer. Evidence around the roles of stress, sleep, and social interaction in the risk factor spectrum is emerging - even regular sauna bathing may play a role. As doctors, politicians, and leaders know, changing the life choices of another person is difficult. While medicine may remain universal, successful attempts at behavioural change are determined by the cultural, psychological, and societal setting, different in each country. The talk will cover past, present, and planned national and international programs aimed at improving stroke risk factor profiles in the population.



**Are new anti-diabetics good for stroke prevention?**

Thomas Truelsen

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Large randomized clinical trials in patients with diabetes have examined the outcome of Major Adverse Cardiovascular Events (MACE) of the new anti-diabetics Glucagon-Like peptide 1 Receptor Agonists (GLP-1 RA) and sodium-glucose-transporter-2 inhibitors (SGLT2). Both classes have demonstrated significant reductions in MACE, but only GLP-1 reduced the risk of stroke in patients with diabetes. In the REWIND study, treatment with the GLP-1RA dulaglutide once weekly or placebo the primary MACE outcome was reduced by 12% (HR, 0.88 [95% CI, 0.79–0.99];  $P=0.026$ ) with dulaglutide, while the nonfatal stroke component of MACE was reduced by 24% (HR, 0.76 [95% CI, 0.61–0.95];  $P=0.017$ ). The GLP-1 RA semaglutide was tested in SUSTAIN-6 versus placebo once weekly, where the occurrence of MACE was reduced by 26% (HR= 0.74 [95% CI, 0.58–0.95];  $P=0.02$ , with the nonfatal stroke component of MACE being reduced by 39% (HR = 0.61 [95%CI, 0,38-0,99];  $P = 0.04$ ). Guidelines have been updated in many countries recommending that in patients with diabetes and ischemic cerebrovascular disease, GLP-1 RA therapy should be added to metformin independently of baseline HbA1c. The ongoing SELECT (Semaglutide Effects on Heart Disease and Stroke in Patients With Overweight or Obesity) trial (<https://www.clinicaltrials.gov>; NCT03574597) is evaluating the impact of semaglutide 2.4 mg once weekly in individuals with obesity or overweight with CVD but not diabetes and has nonfatal stroke as a prespecified secondary outcome. The presentation will provide an overview of results from key randomized clinical trials/meta-analyses and discuss ongoing trials; current stroke treatment guidelines and how it could impact the stroke clinician counselling the patients.

## **New insights into lipid lowering medication in stroke prevention**

Petra Ijäs

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Dyslipidemia, particularly high low density lipoprotein (LDL) cholesterol, is a major risk factor for ischemic stroke and TIA. High quality evidence from randomized controlled trials have shown that HMGCoA-reductase inhibitors, statins, that lower LDL cholesterol lead to significant reduction in the rate of any stroke compared to no lipid-lowering therapy (OR 0.89, 95% CI 0.78–0.99). There may be a small increase in the rate of haemorrhagic stroke related to statin use (OR 1.55, 95% CI 1.09–2.21), but this is compensated by the reduction of other cardiovascular events; overall there is a reduction of any major cardiovascular event in people treated with a statin compared to no lipid-lowering therapy (OR 0.78, 95% CI 0.70–0.87). The evidence supports aiming for an intensive LDL reduction (<1.8mmol/l or 70mg/dl) rather than moderate. This is particularly important in patients with symptomatic intracranial or extracranial artery stenosis where a more intensive LDL target of LDL < 1.4 mmol or < 55 mg/dl is recommended by the ESO and ESC/EAS guidelines. In stroke and TIA patients who do not achieve the recommended LDL-C targets despite taking maximally tolerated dose of statin for at least 6 weeks, ezetimibe can be added to reduce the risk of recurrent major cardiovascular events. Furthermore, in high-risk patients still not meeting LDL-C targets despite maximally tolerated statin dose and ezetimibe, the use of a PCSK9 inhibitor could be considered. Statins carry side effects, especially muscle and liver toxicity that limit their tolerability especially at high-intensity doses. Recently, several novel agents have gained FDA approval, which have proved LDL reduction even not yet been shown to improve stroke or other cardiovascular outcomes. Inclisiran is a small, interfering RNA agent that inhibits PCSK9 and reduces LDL approximately 50%. Bempedoic acid blocks ATP-citrate lyase, an enzyme upstream of HMG-CoA reductase, and reduces LDL by approximately 20%. Evinacumab is an intravenous inhibitor of angiopoietin-like protein 3, an inhibitor of lipoprotein lipase, which lowers triglycerides but can also reduce LDL by up to 49%. Furthermore, human genetic findings have substantiated several other novel targets for lipid-lowering therapy including lipoprotein(a), apolipoprotein C-III, angiopoietin-like protein 4 and apolipoprotein V. Overall, although statins continue to be the gold standard, non-statin therapies may have an increasingly important role in managing dyslipidemia in the future.

**Adherence to secondary prevention medications after stroke – Can we do better?**

Riina Vibo

*Department of Neurology and Neurosurgery, University of Tartu, Estonia*

A majority of strokes can be prevented through optimized management of stroke risk factors. Numerous studies and treatment guidelines assist stroke neurologists in finding the best possible secondary prevention strategy for each stroke survivor. Stroke diagnosis has a long-lasting impact on a person's life. Rehabilitation and recovery, which help patients return to their normal lives, should go hand in hand with secondary prevention to prevent stroke recurrence. This journey presents with several challenges and every member of a stroke care team must contribute their expertise in the best possible way. In addition to suggesting lifestyle changes, usually several medications are prescribed. Patients must understand that the effectiveness of secondary stroke prevention is mostly in their own hands. Poor adherence to prescribed medications in chronic diseases is a well-known, but often neglected problem. Patient education by the stroke care team and support from both medical personnel and family is of utmost importance in keeping the adherence to its maximum.

**Improving translational research**  
Johannes Boltze  
*University of Warwick, United Kingdom*

**Advances in stroke biomarker discovery**

Tarja Malm

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Biomarkers for ischemic stroke are needed to guide therapeutic intervention, to monitor treatment responses and to differentiate stroke subtypes. Effective development of biomarkers is hindered by stroke heterogeneity that individually affects each stroke survivor and thus a detection of a single altered molecule in blood or plasma is unlikely able to have a true biomarker value. Extracellular vesicles (EVs) have opened a new era in the field of biomarker discovery. Brain-derived EVs secreted to the blood stream may carry molecules indicative of brain status of stroke patients. Our data show that ischemia induces a temporal neuronal release of heterogeneous EVs containing miR-21a-5p and the change in the miR-21a-5p level could be observed from the EVs before it becomes detectable at the cellular level. Using quantitative proteomics, we detected rapid changes in the proteomes of both the brain tissue and the EVs. Our analysis suggested that neurons and microglia are the main cell types inducing EV release upon ischemic stroke. Isolation of cell-specific EVs in the blood stream of stroke patients for in depth characterization may serve potential for stroke biomarker discovery.

**Preclinical strategies to improve stroke recovery in diabetes**

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Type 2 diabetes (T2D) increases the risk of stroke and worsens neurological recovery after stroke. While large clinical studies have addressed the potential efficacy of different strategies to reduce stroke risk in T2D, few have investigated whether it is possible to improve neurological recovery. We hypothesized that since T2D is closely linked to obesity, weight loss and consequently improved metabolism before stroke could improve neurological recovery. The aim of our studies was to determine whether weight loss achieved by a diet change or pharmacological glucagon-like receptor 1 (GLP-1R) activation, can improve neurological recovery after stroke in the T2D and obese mouse. Recently published and preliminary results show that both interventions are effective to improve neurological recovery after stroke in T2D and point out improvement of insulin resistance as one of the main mechanisms involved. The medical need in stroke recovery in T2D is dramatically growing due to the global epidemic of diabetes, the increased stroke incidence in the T2D population and the lack of specific cures. The results from our studies could be relevant to develop new therapies targeting obesity & insulin resistance in T2D, in the preventive perspective to limit stroke sequelae. This could have significant clinical implications.

**ER resident protein MANF with neurorestorative and immunomodulatory effects**

Mikko Airavaara

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Ischemic and haemorrhagic strokes are devastating medical conditions with limited treatments to hasten recovery. Resident cells in the brain fail to cope with the cellular stress resulting in massive cell death. A potential strategy to improve stroke outcomes is to modulate endogenous cell-stress pathways. One of the conserved pathways in the unfolded protein response (UPR), an evolutionarily conserved stress response, is initiated when proteins misfold in the endoplasmic reticulum's lumen. It provides a promising opportunity to ameliorate the stressed cell's survival and enhance endogenous reparative pathways after stroke. Recent studies suggest that mesencephalic astrocyte-derived neurotrophic factor (MANF), a small protein, is UPR responsive gene with an active role in maintaining protein homeostasis (proteostasis). Its pre-clinical efficacy has been demonstrated in several disease models, such as diabetes, Parkinson's disease, retinal degeneration, and stroke. MANF has an ER-signal peptide that targets into the secretion pathway after translation. However, unlike canonical secretory molecules, e.g., neurotrophic factors, it has an ER-retention signal. Indeed, it is secreted only by ER calcium depletion. We have revealed many aspects of its mode of action in the recent year. Conducted experiments suggest that the endogenous MANF in the ER lumen and exogenously administered MANF protein have different mechanisms of action. We have found that MANF has neuroprotective effects when it is given before distal middle cerebral artery occlusion (dMCAo), either via protein or with an adeno-associated viral (AAV) vector. When giving MANF to rats 2-7 days after stroke, we discovered that it promoted functional recovery of the animals without affecting the lesion volume. Also, we have found that MANF treatment increased the number of phagocytic myeloid cells and the number of developing neurons in the subcortical peri-infarct regions, suggesting that MANF enhances endogenous reparative processes. These results align with studies done with MANF knockout mice, where we have found that lack of MANF hinders the development of the mouse cortex without modulating the proliferation of neuronal stem cells. We have also found the neuroprotective effects of endogenous MANF against ischemic injury. The beneficial effect of MANF treatment suggests that MANF-like therapies could be used to repair brain tissue after a stroke.

**Cryptogenic stroke - matter of heart and age**

Nicolas Martinez-Majander

*Helsinki University Hospital, Finland*

Several criteria have been proposed for the minimum diagnostic work-up for cryptogenic ischemic stroke. According to the guidelines of American Heart Association/American Stroke Association, minimum baseline evaluation should consist of non-contrast brain and carotid artery computed tomography or magnetic resonance imaging, complete blood count, electrocardiogram (ECG), markers of cardiac ischemia, and serum electrolytes. However, it is evident that the proportion of cryptogenic stroke diminish if timely additional examinations are done, including prolonged ECG monitoring, also intracranial artery imaging, both transthoracic echocardiography and transesophageal echocardiography, and extended laboratory measurements to reveal any prothrombotic states. These additional examinations may reveal underlying conditions associated with the cryptogenic stroke (more often age-specific), namely patent foramen ovale, cardiomyopathy, occult atrial fibrillation, and active cancer. Furthermore, most cryptogenic strokes appear embolic, leading also to the term Embolic Stroke of Undetermined Source (ESUS). However, randomized trials found no benefit with anticoagulation (NOACs) compared to antiplatelet therapy (aspirin) for secondary stroke prevention after ESUS. Still more personalized strategies are needed to guide etiological investigations and treatment of CIS.



## **Advanced imaging in identifying cardioembolic sources**

Marja Hedman

*Kuopio University Hospital, Heart Center and Clinical Imaging Center, Kuopio, Finland*

The diagnosis of cardioembolic stroke remains difficult because a potential cardiac source of embolism does not establish the stroke mechanism. The role of cardiac imaging, transthoracic echocardiography (TTE), transoesophageal echocardiography (TOE), cardiac computed tomography (CT), and magnetic resonance imaging (MRI), is essential in the diagnosis of potential cardiac sources of embolism and for therapeutic guidance. The conventional imaging methods, TTE and TOE, are highly accurate for detecting left atrial appendage (LAA) thrombosis in patients with atrial fibrillation, valvular and prosthesis vegetations and thrombosis, aortic arch atheroma, patent foramen ovale, atrial septal defect, and intracardiac tumours. However, the detection of small apical left ventricular thrombi and differentiation of slow flow from solid thrombosis in LAA with TTE/TOE is often challenging. Furthermore, TOE carries limitations regarding its availability, discomfort and need for patient co-operation. Both CT and MRI are proven to be sensitive in the detection of cavity and valvular prosthesis thrombosis and intracardiac tumours. Many studies have showed that cardiac CT is a very useful modality also for the risk assessment in patients with stroke. With the modern CT technology, the radiation exposure and need for contrast agent has significantly decreased. Also, the 24/7 availability of the method even in small hospitals, make it very attractive method in screening cardioembolic sources. Cardiac CT can be easily accompanied to routine brain and cerebral artery CT imaging without marked increase in radiation or contrast agent, even in duty hours. Cardiac CT can also be used to simultaneously diagnose coronary artery disease in stroke patients. Cardiac MRI has its advantages as safe and accurate method in detecting cardiac sources for stroke, especially with its high sensitivity and specificity in the diagnosis of myocardial diseases. It is superior to CT as it does not expose for radiation. But the limitation of the method is its poor availability and high costs. Modern applications of imaging, such as 3D echocardiography, functional CT imaging and 4D flow MRI are under investigation in several areas of screening for cardioembolic stroke. Also, new methods of nuclear imaging will give new information of the potential sources of embolic strokes in the future. In conclusion, cardiac CT and MRI are reliable alternative and additive imaging modalities to TTE/TOE for the evaluation of cardioembolic sources in patients with ischemic stroke, avoiding the discomfort and risks associated with TOE and should be considered in the detection of a cardiac source of embolism.

## **When to start oral anticoagulants after acute ischemic stroke in patients with atrial fibrillation?**

Per Wester

*Umeå University and Karolinska Institute Danderyds hospital, Sweden*

Cardioembolic stroke due to nonvalvular atrial fibrillation accounts for 13-26 percent of all ischemic stroke cases. There is a high risk of ischemic recurrence within the first two weeks after stroke onset. Non-vitamin-K-antagonists (NOAC-s) are effective in preventing ischemic stroke recurrence but are also associated with an increased risk of intracranial hemorrhage. The timing, i.e., when to initiate oral anticoagulation in ischemic stroke patients with atrial fibrillation has been largely unknown with a wide variance in international guidelines based on consensus. Until recently there were no data from large randomized controlled trials in this field. As today, two pivotal large RCTs have so far been published, the TIMING and the ELAN studies and a third (OPTIMAS) will soon be finalized.

The TIMING was a register-based RCT on early (within 4 days) vs later (5-10 days) initiation of NOAC in patients with ischemic stroke and atrial fibrillation. The primary endpoint was recurrent ischemic stroke, intracranial hemorrhage and death within 3 months. The study was primarily set as a non-inferiority with a 3% margin with secondary superiority testing. The TIMING study was closed after 888 patients had been recruited (originally planned sample size 3000 patients). Early initiation of NOAC was found to be non-inferior to later start ( $p < 0.004$ ). Furthermore, early NOAC start was found to be safe with lower rates of ischemic stroke and death and with absence of symptomatic intracerebral hemorrhages both early and late.

The Early versus Later Anticoagulation for Stroke with Atrial Fibrillation (ELAN) study was an investigator-initiated RCT at 103 sites in 15 countries encompassing 2013 participants randomized to earlier vs later NOAC initiation. The timing of initiation of treatment was staggered according to the size of the infarct or severity of the stroke, so that early treatment meant starting within 48 hours after a minor or moderate stroke or on day 6 or 7 after a major stroke. The timing of anticoagulation in the control (later-treatment) group was according to the "3-6-12-day rule" NOAC start at 3 (minor), 6 (moderate), or 12 (major) days according to the European Heart Rhythm Association consensus guidelines. The primary outcome was a composite of recurrent ischemic stroke, systemic embolism, major extracranial bleeding, symptomatic intracranial hemorrhage, or vascular death within 30 days. A primary-outcome event occurred in 29 participants (2.9%) in the early-treatment group and 41 participants (4.1%) in the later-treatment group (risk difference,  $-1.18$  percentage points; 95% confidence interval [CI],  $-2.84$  to  $0.47$ ) by 30 days. Intracranial hemorrhage was only found in 4 cases, 2 in each arm. In summary, early initiation of oral anticoagulation in subjects with ischemic stroke and atrial fibrillation appears safe and intracranial hemorrhage is rare. Additional results from the OPTIMAS trial in the UK with similar setting as the Swedish TIMING are soon to be expected with more than 3200 subjects so far recruited.

**Current status of left atrial appendage closure in stroke prevention among patients with atrial fibrillation**

Dorte Damgaard

*Aarhus University Hospital, Aarhus, Denmark*

The Left atrial appendage (LAA) is the source of thrombus in approximately 90 % of patients with non-valvular atrial fibrillation. 15 - 20 % of ischemic strokes is related to atrial fibrillation. Oral anticoagulation (Warfarin and DOACs) reduces the risk with about two thirds. In patients with previous stroke the annual risk of recurrent stroke is about 2 % with oral anticoagulation. LAAO as an alternative to oral anticoagulation (OAC) in patients eligible to OAC, has been investigated in three randomized trials. In two out of three trials LAAO is non-inferior to OAC and a meta-analysis has shown a lower risk of hemorrhagic stroke with LAAO. LAAO in addition to OAC seems to reduce the risk of stroke further.

**Adaptive brain plasticity after stroke - Evidence from preclinical models**

Karsten Ruscher

*Laboratory for Experimental Brain Research, Lund University, Sweden*

Stroke causes neurological impairment due to cell loss predominantly in the affected neuronal tracts and circuits. In addition, neurological deficits are due to dysfunction of remaining neurons in the vicinity to or in areas remote from the infarct connected through brain-wide neural networks. Indeed, information processing in brain regions distant from the ischemic territory is impaired after experimental stroke. Therefore, the affected neuronal networks are considered as neuronal substrate for adaptive plasticity processes and recovery promoting therapies modulating mechanisms of brain plasticity. Brain plasticity comprises the ability of the brain to reorganize its cellular structures and its function in response to intrinsic and extrinsic stimuli. Brain plasticity can be stimulated in stroke patients by multimodal rehabilitation through various advanced training paradigms. Virtual reality or computer gaming can support rehabilitation with promising results. In preclinical studies, this is accomplished by an enriched environment, comprising large cages with toys, tubes, ladders, and larger groups of animals with the opportunity for more complex social interaction that activates various neural networks of the brain. Moreover, several pharmacological treatments modulate the function of neuronal circuits and therefore enhance recovery of lost neurological function after stroke. Here, we will present an overview on the current knowledge of adaptive plasticity processes after acute brain injuries, i.e., ischemic stroke.

## **Pharmacological Promotion of Neuronal Plasticity**

Eero Castrén

*Neuroscience Center, University of Helsinki, Finland*

Neuronal plasticity is a critical mechanism underlying resilience and recovery from stroke and other brain insults. Plasticity is also critical mediator of the antidepressant effects. Our previous studies have shown that antidepressant drug treatment promote neuroplasticity and resilience. Beneficial effects of are not produced by the drug treatment alone, but drug treatment needs to be combined with training that guides the changes in neural networks rendered plastic by antidepressant treatment. We have shown that many, if not all antidepressant drugs (including typical drugs SSRIs and tricyclics, but also the rapid-acting ketamine and psychedelic compounds LSD and psilocybin) act by directly binding to TrkB, the receptor for brain-derived neurotrophic factor (BDNF) and allosterically increasing BDNF signaling. The plasticity-promoting and antidepressant-like effects of various drugs known to have antidepressant effects are lost in mice with a mutation in TrkB that is otherwise silent but prevents drug binding to TrkB. We have also shown that the effects of antidepressants are predominantly mediated by TrkB receptors on the parvalbumin-expressing interneurons and that the activation of TrkB in these neurons reduces the expression of parvalbumin and the density of perineuronal nets, thereby reducing their inhibitory control of pyramidal neurons and promoting network activity through disinhibition. These findings have dramatic effects of our understanding of the antidepressant drug action. They emphasize that to bring about a functional benefit, antidepressant drug treatment needs to be combined with rehabilitation that guides the plastic networks towards recovery. Through promoted plasticity, a combination of antidepressants or other positive allosteric modulators of BDNF signaling may be beneficial for the recovery from stroke.

**Fluoxetine cons**

Katharina Stibrant Sunnerhagen

*University of Gothenburg, Gothenburg, Sweden*

Fluoxetine, in spite of its promising results in animals' models, have failed to demonstrate effectiveness in large clinical trial. The three trials, FOCUS, EFFECTS and AFFINITY, with all together more than 5000 participants showed no effect on motor recovery. On the other hand, there were known side effects, such as fractures in the treated group. There is no evidence to use fluoxetine in patients with stroke in order to enhance motor function.

**Therapeutic brain plasticity: future perspectives**

Andrew Clarkson

*REGENBIO Consultants Limited, Dunedin, New Zealand*

Stroke is the leading cause of adult disability. Animal and human studies have shown that the brain can engage in a limited process of neural repair after stroke: re-mapping of sensory and motor functions and sprouting of new connections in peri-infarct cortex surrounding the stroke. A fundamental process that underpins this re-mapping is neuroplasticity, which is the ability of the nervous system to respond to either intrinsic or extrinsic stimuli, physical, electrical or pharmacological etc, that ultimately results in structural, functional and connective reorganisation. A limiting factor is that our understanding of neuroplasticity comes from examining pure cortical infarcts in animals where there is a great capacity for reorganisation to occur within surrounding grey matter. However, these findings are being applied to strokes in humans that are predominantly white matter in origin. Herein, I will discuss fundamental differences in treating strokes that result in either motor impairments or delayed impairments in cognition. Interestingly, neuronal excitability which is an underlying contributor for neural repair and plasticity appears to be fundamentally different between motor and cognitive impairments, with treatments showing benefits for motor impairments, showing neutral to negative effects for cognitive impairments.

**Ancillary imaging to guide recanalization therapies of acute ischemic stroke – harm or benefit**

Sami Curtze

*Helsinki University Hospital, Neurology, Finland*

Recanalization therapies have emerged as highly effective treatments for acute ischemic stroke within specific time windows. Thrombolysis therapy and endovascular treatment have demonstrated success within 4.5 hours and 6 hours, respectively. Penumbra imaging has expanded these time frames by identifying patients who may benefit from treatment up to 9 hours for thrombolysis and up to 24 hours for endovascular interventions. However, the strict selection criteria of previous trials have left many patients untreated, prompting recent research to focus on inclusivity and identifying patients who may benefit from recanalization therapies. This raises questions regarding the harm-to-benefit ratio for patients with large infarct cores or those who arrive beyond the established time windows. Should penumbra imaging be conducted within any time frame to identify patients with salvageable tissue, or should we reconsider the role of penumbra imaging and time windows altogether, opting for the immediate opening of vessel occlusions even in cases with large infarct cores?

Balancing Harm and Benefit: The selection of patients for recanalization therapies based on penumbra imaging holds promise for expanding the treatment window and maximizing benefits. By identifying salvageable tissue, penumbra imaging allows clinicians to make informed decisions about intervention, potentially offering life-saving treatments to patients who would otherwise be excluded. However, the inclusion of patients with very large infarct cores and those beyond the established time windows raises concerns about potential harm and use of resources. In the case of patients with large infarct cores, the risk-benefit analysis becomes more complex. Opening vessel occlusions in these cases may not yield substantial clinical improvement and could expose patients to unnecessary risks. Regarding patients presenting beyond the established time windows, the balance between harm and benefit becomes even more critical. While penumbra imaging has demonstrated extended treatment possibilities, its applicability and effectiveness in such cases require careful evaluation. The potential benefits of recanalization therapies must be weighed against the risks of procedural complications and the possibility of futile interventions. The presentation will elaborate recent trial evidence.



**Contribution of ultrasound examinations in the etiologic evaluation of patients with ischemic stroke/ TIA**

Ulrike Waje-Andreassen

*Dep. of Neurology, Haukeland University Hospital, Bergen, Norway*

Due to huge technical progress, the field of neurosonology belongs today to the essential, individual diagnostics, available bed-side for any patient at any age. From decisions to start treatment in children with sickle cell anemia, ultrasound is applied in daily clinical practice for individual evaluation about the state of the arteries related to time of established hypertension, diabetes mellitus, dyslipidemia and other cardiovascular risk factors. Patients with critical focal cerebral flow may profit from daily follow-up over a certain time period for choice of best individual treatment options. In addition, ultrasound images are a valuable pedagogical tool for patients and their family members, including also end of life evaluations.

This lecture has its focus on the important contribution of neurosonology in evaluating the cause of an acute ischemic cerebral event, such as

- Carotid walls, metabolic syndrome and inflammation
- Right-left shunt detection
- Spontaneous microembolic signals

## **Imaging of intracerebral hemorrhage**

Michaela Bode

*Oulu University Hospital and University of Oulu, Finland*

Intracerebral hemorrhage (ICH) causes approx. 15% of all strokes. It can be spontaneous or traumatic in nature. This presentation focuses on the imaging modalities used in the diagnosis and follow-up of spontaneous ICH. In addition, key findings in most common etiologies and prognostic imaging markers for spontaneous ICH are described.

## **Neuroimaging patterns associated with clinical outcomes**

Arne G Lindgren

*Neurology, Lund University and Skåne University Hospital, Sweden*

**Background:** Many factors have been related to clinical outcomes after ischemic and haemorrhagic stroke. These include age, premorbid modified Rankin Scale score, concomitant diseases, NIHSS, acute recanalization treatment, biomarkers, genetic factors, and rehabilitation measures. These variables may have different impact depending on which outcome that is of interest - functional outcome, motor/cognitive/language function, complications after stroke, recurrent stroke, or mortality. Biomarker parameters such as neuroimaging findings have been related to outcome, but it has sometimes been difficult to show that neuroimaging adds independent prognostic value to clinical factors.

**Neuroimaging and clinical outcome:** Neuroimaging features for ischemic and hemorrhagic cerebrovascular disease include tissue damage characteristics e.g., lesion location, size, type of imaging modality showing lesion, and concomitant edema. The cerebrovascular situation regarding stenosis/occlusion and collateral blood flow is of great importance. Neuroimaging signs of concomitant cerebrovascular disease such as white matter hyperintensities (WMH), microbleeds, cerebral amyloid angiopathy, cortical superficial siderosis, enlarged perivascular spaces, cortical microinfarcts, and silent localized lesions (mainly infarcts) may influence outcome. Functional neuroimaging can determine remaining capacity of specific cerebral regions.

**Examples of reported associations between neuroimaging patterns and clinical outcome:**

Collateral blood flow assessed with CTA or MRI and favourable clinical outcome; lesion location and stroke severity according to NIHSS; sex-specific lesion location differences, brain volume, and increased severity of WMH and functional outcome after ischemic stroke; corticospinal tract integrity and motor outcome after stroke.

**Conclusion:** There is a need to combine different potential clinical and biomarker predictors to obtain best possible individual prediction of clinical outcome in cerebrovascular disease. Both CT and MRI tissue imaging, vascular imaging, and functional imaging are related to stroke outcome and have potential to add information for determining outcome and prognosis in cerebrovascular disease.

**Intelligent technology to enable decentralized neurorehabilitation**

Olivier Lambercy

*ETH Zurich, Switzerland*

Neurorehabilitation after stroke faces many open challenges due to the increasing number of patients, the limited number of healthcare professionals and the raising healthcare costs, which ultimately impacts the therapy dose patients receive. Simple technology-based solutions could enable a paradigm shift in stroke neurorehabilitation models currently heavily relying on hospital stays/visits. In this presentation, I will describe our work on the development and clinical evaluation of robot-assisted technologies to support hand rehabilitation of stroke patients along the continuum of care, from the hospital bedside to their home. I will discuss key enablers and challenges in view of the development and acceptance of such technologies in neurorehabilitation.

## **Standardized measurement of upper limb recovery after stroke – recommendations and implementation**

Margit Alt Murphy

*University of Gothenburg, Gothenburg, Sweden*

Agreement on a core set of reliable, valid and accessible outcome measures to assess rehabilitation outcomes is needed to generate strong evidence about effectiveness of rehabilitation interventions. Several initiatives have been launched to agree on core outcome measures for stroke research and clinical practice. Additionally, incorporating measures of movement quality (e.g., kinematics or observational movement analysis) and actual use of the affected arm in daily life (e.g., accelerometry), can provide valuable insights into motor recovery, motor control and movement performance. This presentation provides an overview of the recent guidelines and recommendations and provides a practical example for clinical implementation.

**Assessment instruments for evaluation of stroke outcomes**

Terry Quinn

*School of Cardiovascular and Medical Sciences, University of Glasgow, Scotland*

Assessing recovery following stroke is an essential part of clinical practice and research. However, assessment of stroke survivors is not always straightforward, and the variety of differing tools and terminologies can be confusing. In this lecture, suited to the non-specialist, Dr Terry Quinn will introduce some of the commonly used stroke assessment tools with the aim of demystify the theory and improving the application and understanding of these tools. The talk will include discussion of exemplar tools that can be used to assess impairment, activity, societal participation, and quality of life in stroke. The tools discussed will include the Medical Research Council muscle power scale, the Barthel Index of activities of daily living (BI ADL), the modified Rankin Scale (mRS), the Montreal Cognitive Assessment (MoCA) and others. These tools will be used as a platform to discuss the general topic of psychometric properties of clinical measurements. By exploring the advantages and limitations of stroke assessment tools, and their application through case studies, the relevance of psychometrics to both clinical practice and research will be demonstrated. Finally, future directions in outcome assessment will be explored with examples of how new technology can standardise and improve assessment.

**Smart garment and immersive exergaming to enhance feedback of upper limb training**

Timo Siponen

*Andritz Oy, Finland*

Aalto University Vireamed project developed Virtual Reality rehabilitation solution for stroke motor function rehabilitation. Project started early 2019 and was closed in September 2022. Project consisted of two user test rounds and several patient and rehabilitation professional surveys. Feedback was collected from total 45 patients and rehabilitation professionals. Presentation presents the idea of the solution, project achievements and findings. Vireamed rehabilitation solution provided independent, self-guiding and recording Virtual Reality exercise environment. Solution analyzed correctness of patient movements and provided real time feedback to the patient. Aim was to use VR to for patient independent training and with that split the total training amount into smaller, more effective training sessions. Aim was to maximize the neuroplasticity period opportunity for motor function recovery. With remotely connected solution the aim was to help patients to train independently and even remotely but still be under care professional surveillance. The presenter, Timo Siponen was leading the project since end of 2019 until the end of the project. Timo currently works as Product Director in pulp- and paper industry (Andritz Oy) and has longer affiliation to the subject.

**The results of surgical evacuation of ICH as evaluated by novel biomarkers**

Juhana Frösen

*Tampere*



**Long-term prognosis of intracerebral hemorrhage**

Sami Tetri

*Oulu University Hospital, Neurocenter Oulu, Finland*

**Prognosis of poor grade aneurysmal subarachnoid hemorrhage**

Olli-Pekka Kämäräinen

*Kuopio University Hospital, Finland*

Aneurysmal subarachnoid hemorrhage (aSAH) is the third frequent form of stroke and even though the prevalence of this disease has been steadily declining, it is still affecting especially the working age population in the Nordic Countries. Significant proportion of aSAH patients are admitted to neurocritical care in comatose condition (Hunt & Hess grades IV and V). Knowledge of their long-term survival and quality of life has previously been limited. Besides bleeding into the subarachnoid space, these patients often suffer from intractable intracranial pressure, hydrocephalus, intracerebral hemorrhage, reactive vasospasm, seizures, cardiac and pulmonary dysfunction, electrolyte disturbances and delayed brain ischemia. This talk aims to present current known factors that affect individual prognosis and to offer tools for clinical decision making concerning aSAH patients with severe neurological condition in the acute phase of the disease.

## **Functional outcome of aneurysmal subarachnoid hemorrhage**

Angelika Sorteberg

*Dept of Neurosurgery, Oslo University Hospital, Norway*

Even though the mortality of aneurysmal subarachnoid hemorrhage (aSAH) varies largely with the severity of hemorrhage ranging from <10% in WFNS grade 1 and 2 patients to approximately 75% in WFNS 5 patients, functional outcome of survivors is much less closely linked to the severity of aSAH. Survivors of aSAH differ from those that have suffered ischemic stroke in that there are few vegetative individuals across the entire range of aSAH severity and many recover without obvious neurological deficits. Cognitive dysfunction is the most common neurological impairment with reduction in visual and verbal memory being the most affected domains alongside difficulties with problem solving and initiation. Intellectual functioning often remains unimpaired. Patients that developed delayed cerebral ischemia, those with post-hemorrhagic hydrocephalus, and elderly have poorer neuropsychological performance across the entire range of aSAH severity. Favourable outcome in terms of a modified Ranking score of 0-2 at 6 months after the ictus is achieved by > 90% of WFNS grade 1 patients and almost half of grade 5 patients. In light of this, return to work (RTW) is strikingly low, with only about one third of survivors achieving a full return to work and 15-20% a partial return to work within 3 years after the ictus. Full RTW is equally lower in WFNS grades 3-5 (15.6 – 19.0%) than in WFNS grades 1-2 (44.4% and 35.5%). Higher education is independently protective against no RTW. WFNS grade 3 is an independent predictor of no RTW, as is age, active smoking and foremost the presence of chronic clinically significant fatigue. Fatigue is the core somatic symptom of the post-aSAH syndrome that comprises a cluster of fatigue, cognitive and emotional problems. Post-aSAH depression and anxiety are frequent and intensified in those with a pre-ictal history. Depression, anxiety, and passive coping style are strongly linked to chronic fatigue, in particular in those without physical and cognitive impairment. Fatigue beyond one year after the aSAH is present in about 70% of the patients when evaluated with the fatigue severity scale and it usually improves only little over time. Post-aSAH fatigue is prevailing of mental type rather than physical and characterized by lack of motivation and stress intolerance. Smokers, those with GCS< 15 and those with severe vasospasm are more prone to develop chronic post-aSAH fatigue.

## Caregivers' situation after stroke

Susanne Guidetti, Malin Erneby, Gunilla Eriksson  
*Karolinska Institutet, Sweden*

**Background and aims:** Stroke could cause consequences and limitations in the performance of activities in everyday life that could persist a long time. A family member might need to care for and assist the person who has had a stroke. The life situation of these caregivers thereby changes, which could lead to increased workload and new responsibilities in caring for which they lack but request knowledge. This presentation will present a mobile phone supported rehabilitation called F@ce where also the caregivers become involved in the rehabilitation process. The aim of the study was twofold, (1) to describe the caregivers experiences over time and, (2) the experiences of the intervention F@ce 2.0 that was integrated into the rehabilitation that the person who have had a stroke has participated in.

**Method:** Qualitative interviews (n=13) were conducted with caregivers (n=7) to persons who had participated in the F@ce 2.0. The interviews were performed after 8 weeks of intervention and 6 months after the intervention ended. Content analysis was used to analyse the interviews.

**Findings:** Six categories were identified during the data analysis of the interviews with the caregivers: Impact on facilitation of activities; the importance of being able to both offer and receive support; the commitment linked to the intervention; worry and dejection change over time; impact on roles and relationships; the need for development and continuation of the intervention.

**Conclusion:** The caregivers experience that the anxiety surrounding the new situation following a stroke decrease over time and that it becomes easier to resume previous activities. The study shows that through participating in F@ce 2.0 the caregivers experienced support in their own activities, managing their anxiety and relationships. The findings amplify the importance of person-centeredness and that the caregivers needed to take part of the assessment regarding activity limitation and participation restriction. The intervention was also shown to not be suitable for everyone. There is a need for future development of interventions that are supported by information and communication technologies, but most important also directed to caregivers.

**Mind the patient perspective!**

Kaj Kunnas

*Nykarleby*



**Tools to support follow-up**

Emma Kjörk

*Göteborgs universitet, Sweden*

After a stroke, a standardised follow-up is important since people often live with stroke-related consequences in the long term. Furthermore, psychosocial and cognitive impairments can lead to limited use of health information and difficulties to access health care. Stroke guidelines recommend the use of the post-stroke checklist (PSC) to identify common health problems and initiate further interventions. The PSC can be used with different mode of delivery, such as face-to-face and, proxy or digital, in different settings after stroke. To support the dialogue at the visit, a digital pre-visit tool, based on the PSC and health information, called Stroke Health™, can be used. During the oral presentation at the congress an example of a standardised follow-up model using the PSC will be described. The presentation is based on published and unpublished studies involving people, who had a stroke, and healthcare professionals regarding the use of the PSC and the pre-visit tool. Qualitative interviews, focus group discussions, surveys and a participatory co-design approach has been conducted. The PSC was perceived as a useful tool by patients and healthcare professionals in the studies. The dialogue between the patient and the health professional was emphasized to capture health problems and initiate further interventions. Furthermore, the digital pre-visit tool Stroke Health™ has the potential to help patients prepare for a follow-up visit. The tool is free to use and is available digital, paper in several languages and a picture supported version. (<https://www.gu.se/neurovetenskap-fysiologi/strokehalsatm-uppfoljning-efter-stroke>). Findings underlying the presentation suggests a model for follow-up using PSC as a digital pre-visit tool, face-to-face and proxy. Findings show the PSC identifies health problems, was perceived as useful and a digital tool with potential to make people better prepared for a visit. The importance of the dialogue with the patient's and healthcare staff's expertise was highlighted.

## **The Finnish Brain Association: Patient Organisation Perspective**

Mika Pyykkö

*Finnish Brain Association, Turku, Finland*

Finnish Brain Association is about 46 years old organization. Stroke survivors and their close relatives is one of its' two main target groups. It works at the national as well as at the local and regional level. As a NGO Finnish Brain Association has an idea, that make volunteerism possible, peer support and expertise by experience are the most import ways to work – to help and to support stroke survivors and their close relatives. In practice it means different kind of permanent activities and development projects like Seize the everyday, which is for working age stroke survivors. Finnish Brain Association highlights the importance of real collaboration inside its' organization, but also between different NGOs and those and public and private sector. In October 2021, The Finnish Brain Association began preparations for the National Brain Health Program in collaboration with an extensive group of about 50 experts representing different sciences. The program was launched in November 2022 and it examines brain health through the operating environments of three age groups (children and young people, people of working age, and seniors). The preparation of the program was steered by impact-driven thinking and a proactive approach with emphasis on protective factors and it is thereby unique on a global scale. The new perspective on brain health covers brain wellbeing and functional ability. The impact goal of the program is “A humanly sustainable community that supports brain health” and program is planned to be part of a wider entity and supplements existing operations.

## **Tools to talk - a reimplementation study of supported conversation for adults with aphasia**

Mia Loft

*Rigshospitalet, Copenhagen, Denmark*

**Background:** Studies describe good results for implementing supported conversation methods e.g., supported conversation for adults with aphasia (SCA) for use by communication partners with patients with aphasia, as they support a successful exchange of information and the patient's active participation in communicative interactions. However, studies have also shown that nursing staff have been less successful in implementing these methods. This is highly problematic, as these professions have daily contact with aphasic patients and are in a unique position to activate and involve patients in communication.

**Methods:** The UK Medical Research Council's framework for developing and evaluating complex interventions was used as a guide for structuring the research process. We draw on both qualitative (interviews, field observations and content analysis) and quantitative (survey, ratings and descriptive statistics) methods through the four sub-studies. The Behaviour Change Wheel was used as a theoretical framework for developing the implementation strategy.

**Results:** Based on the preliminary sub-studies that uncovered the field of enquiry through a needs assessment, a tailored implementation strategy for the re-implementation of SCA was developed. The implementation strategy consisted of multiple components – for example, a one-day face-to-face course, an E-learning catch-up course, video material, adjusted supporting material and adjusted teaching material.

**Conclusion:** The preliminary results showed the importance of a tailored strategy for the nursing profession to make the SCA method applicable to the profession in daily practice. Additionally, a supportive culture and continuous manager support were of significant importance for successful implementation. The results of the implementation strategy effect study are still to come.



**Organizational conditions as barriers to person-centered nursing and professional care: A qualitative interview study of nurses experiences of pain in patient admitted with stroke**

Maria Brudsø

*Rigshospitalet-Glostrup, Denmark*

**Background:** A structuralized literature review indicates that pain in patients with stroke is not systematically assessed and treated and that nurses experience challenges in regard to assessment and treatment of the patients' pain. This study seeks to elucidate this.

**Method:** The study is based on a phenomenological-hermeneutic approach. A qualitative approach. A qualitative approach is used to collected data using semi-structured interviews. The data is analysed by means of Ricoeur's philosophy.

**Findings:** The nurses' experiences of assessing and treating pain gives rise to the following themes: 1) To Fumble in the Dark. 2) An Unsystematic Experience and 3) Starting Over. As viewed through the conceptual lens of Fundamentals of Care, resources, culture and leadership challenge nurses person-centered care and professional practice.

**Conclusions:** Challenges within the context of nursing care for patients with pain and stroke, causes the nurses to find their professional judgement under pressure. The nursing care becomes deficient with consequences in regard to the patients' rehabilitation and quality of life.

## **ESO Quality in Acute Stroke Care (QASC) project**

Anneli Jaska

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**Introduction:** There is compelling evidence that improved patient outcomes are achieved through early intervention in acute stroke care including thrombolysis, endovascular clot retrieval and access to specialised in-patient stroke units. Hyperglycaemia, swallowing dysfunction and elevated temperature are physiological variables known to be associated with poorer stroke outcomes. Despite evidence that early intervention for stroke results in better patient outcomes, and European guideline recommendations, evidence is not always effectively implemented. The Quality in Acute Stroke Care (QASC) Trial demonstrated that multidisciplinary, nurse-led interventions to manage fever, hyperglycaemia and swallow difficulties (FeSS protocol) following acute stroke significantly improved health outcomes. To evaluate and improve the nursing care quality in stroke patients at Tartu University Hospital, a QASC audit was conducted.

**Methods:** Patient data were collected by retrospective medical record audits for up to 60 consecutive stroke patients, both pre-and post FeSS protocol introduction. Prospective audits were conducted 3 months after FeSS protocol introduction.

**Results:** During March 2021, 60 stroke patients data were collected for the baseline audit and 56 patients were reviewed during the post intervention period October 2021 at Tartu University Hospital. From pre to post implementation there was an increase in the proportion of patients who received better nursing care quality. Fever was monitored four times a day on Day 2 (80% vs 93%) respectively and Day 3 (52% vs 88%). An increase in the proportion of patients observed four times daily for hyperglycaemia on Day 1 (67% vs 95% respectively) and Day 2 (20% vs 89%). An increase in the proportion of patients who received a formal swallow screen (75% vs 82%).

**Discussion:** According to the results from QASC audit at Tartu University Hospital, the FeSS protocols were successfully implemented to the everyday practice resulting in a significantly increased proportion of patients receiving evidence-based nursing care. However, there is room for improvement in the proportion of patients receiving care according to FeSS protocol.

**Implementing dysphagia screening for acute-stroke patients**

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## **Spatial neglect and related disorders in acute stroke care – new screening procedures for bedside use**

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**Introduction:** Spatial neglect (SN) is frequent and results in worse recovery following stroke. In this presentation, I will introduce the results of two sequential research waves to validate bedside screening tools for SN identification in acute stroke settings.

**Patients and methods:** Wave one: Index tests: conventional subtests of The Behavioural Inattention test (C-BIT), an additional figure copying test. Item 9 of the National Institute of Health Stroke Scale was revised to include screening for SN (rNIHSS). Wave two: Index tests were based on results from the first wave: star cancellation, figure copying, and the rNIHSS. The Catherine Bergego Scale (CBS) was used as a reference frame for SN in both waves.

**Results:** Wave one: 126 patients, 24% with SN <14 days post-stroke. If all C-BIT subtests were administered, 35% of stroke patients were incorrectly identified with SN. More patients without SN were identified as having SN if  $\geq$  three C-BIT tests were administered ( $p=0.002$ ). The star cancellation and figure copying were the most sensitive index tests. Inclusion of an additional item to NIHSS correctly identified SN in 80% instances. Wave 2: Out of 98 patients, 21% had SN <7 days post-stroke. SCT had a sensitivity of 80%. Combined use of the SCT and an additional item of the NIHSS identified 85% of SN patients.

**Conclusion:** Results contest the common belief that the use of more tests increases the identification of SN. Rather we found that using a large test battery decreases sensitivity in the acute phase of stroke. Adding a novel item to the NIHSS provided a new way of SN screening. The screening methods are currently undergoing further validation in a cross-country study between Iceland and Lithuania, where 1000 acute stroke patients, or 200 patients with SN will be enrolled. Results should offers solid recommendations for effective screening procedures of SN which are feasible to use in the busy stroke unit.

## **Abstracts for Short Oral Communications**

(in descending order of arrangement in the program)

**Cocaine-induced spinal cord transient ischemic attack: Case report**

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**Background:** Compared with ischemic disorders of the brain, ischemic lesions of the spinal cord in general are rare due to extensive anastomoses in the spinal cord. Since the introduction of crack-cocaine in the 1980s, the number of neurovascular complications following cocaine use has increased. The etiology of cocaine-induced ischemia is unclear, but proposed pathophysiology includes vasculitis, increased aggregation of platelets, cardiogenic embolism due to ventricular fibrillation, as well as sympathomimetic neurotransmitter reuptake blockage.

**Case presentation:** 28-year-old male was hospitalized after acutely presenting paraplegia. The onset of symptoms was believed to be around 12 hours by the time he arrived to ER. Patient had partied the night before and used cocaine for the first time in his life. On waking he was unable to stand up. On examination the patient could not lift his legs, having only minimal movement in his right big toe. Even with weight elimination he was unable to perform extension or flexion from hip, knee and ankle joints. No pathologic reflexes were triggered. His proprioception in legs was disturbed, only distinguishing the right side from the left. There was analgesia up to the inguinal line, hypalgesia up to the lower abdomen and urinary retention. CT scan of thoracic and lumbar region and brain CT were without abnormalities. Acute spinal cord infarction and acute myelitis following a viral infection remained primary diagnostic hypotheses. MRI of thoracic and lumbosacral spine was performed, showing no focal changes, swelling or diffusion restriction indicating ischemia of the cord and no signs of hemorrhage or expansive processes in the spinal canal. By the first evening patient's motor condition had improved minimally, by the next morning his leg motility and muscle strength had largely recovered - enabling to sit, stand up and move around with support. By noon, the sensory disturbances had passed, leg motility and bladder function had returned. Based on examination, imaging studies and the resolution of symptoms within 24 hours, the patient was diagnosed with transient ischemic attack of spinal cord at Th12-L2 level.

**Conclusion:** Transient ischemia of spinal cord is a rarely occurring entity. As cocaine-induced spinal cord ischemic syndrome does not have specific characteristics, cocaine use should also be considered as a possible causative factor in cases of acute non-traumatic myelopathy, especially in younger patients.

## **Hemorrhagic stroke among octogenarians with atrial fibrillation: 30-day case fatality, prior oral anticoagulation, and time trends over ten years**

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**Introduction:** Clinicians often face a challenge when considering thromboprophylaxis for octogenarians with atrial fibrillation (AF) due to their markedly increased risk of bleeding. Whether the recent evolution in OAC treatment affects the severity of intracranial bleeding among these patients is understudied. We examined the changes in 30-day case fatality and prior oral anticoagulation use among octogenarians with HS and first-ever hemorrhagic stroke (HS) over a ten-year period.

**Methods:** We identified the study population from the nationwide registry-linking Finnish AntiCoagulation in Atrial Fibrillation (FinACAF) study. Patients entered the cohort if they had incident AF and a subsequent first-ever HS (ICD-10 I60\* or I61\*) in 2009-2017 at the age of over 84 years. OAC purchases in the previous 90 days were registered.

**Results:** Over the ten years, 513 of the 1,890 patients with prior AF and HS were over 84 years old (median age 88.5 years, 72% women). Of these, 51% had some OAC purchase before the HS event (of women 55%, of men 42%,  $p = 0.007$ ). In 2009-2010, 2/13(15%) patients had a prior OAC purchase, gradually increasing to 73/105(70%) in 2018. The 30-day case fatality was 55% without significant difference between sexes. The case fatality by prior OAC purchase was 57%, 55% and 46% for no purchase, warfarin and NOAC, respectively. Compared to no prior oral anticoagulant use and adjusted by event year and sex, there was no significant difference in the odds of case fatality between patients with prior NOACs (OR 0.83, CI 95% 0.45-1.51) or warfarin (OR 0.93, CI 95% 0.63-1.39). The case fatality increased from 33% in 2009 to 66% in 2014, then decreased to 47% in 2018. After adjusting for sex, and previous oral anticoagulant purchase, there was no significant change in case fatality over the observation period.

**Conclusions:** The use of oral anticoagulants increased from nil to 70% among octogenarians with AF and their first-ever HS, without a significant time trend in the case fatality. The results suggest an association between NOAC usage and 30-day case fatality among these elderly patients.

## **Traffic accidents among motor vehicle drivers with stroke - a national Swedish cohort study**

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**Background and aims:** Driving after stroke are limited with restrictions due to road safety perspective. The aim of the study was to examine frequencies and type of traffic accidents that were associated with motor vehicle drivers with stroke, compared to a comparison group of individuals with Ulcerative Colitis and Crohn's Disease.

**Methods:** This retrospective national wide, registry-based study included all drivers involved in motor vehicle accidents (car, bus/truck, moped/motorcycle) in Sweden from 2010-2019, based on the Swedish Traffic Accident Data Acquisition database. Data on pre-existing diagnoses were retrieved retrospectively from the National Patient Registry. Data analyses included group comparisons and binary logistic regression.

**Results:** In total, 4752 drivers were registered to have been involved in a motor vehicle accident, where of 2788 with stroke, and 1964 in the comparison group. At the time of the accident, the mean time since diagnose in years were 6.7 (0-22) after stroke and 9.1 (0-22) in the comparison group ( $p < 0.001$ ). No significant differences were seen between groups regarding the type of accidents. Car drivers with stroke had 1.25 higher odds (95% CI 1.01-1.56) to be involved in an accident, and suffered more severe injuries ( $p = 0.001$ ), however the number of severe or fatal injuries were overall low.

**Conclusions:** Driver with stroke did not differ significantly in type of accident. However, people with stroke have slightly higher odds for a car accident, and were more severe injured. Over all, these findings may indicate that the driving restrictions in Sweden after stroke may be effective.



## Healthcare professionals addressing post-stroke sexual rehabilitation - A Systematic Review

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**Purpose:** Sexual difficulties are experienced by more than half of all stroke survivors during recovery. Proper guidance could potentially benefit patients. Though recommendations on sexual rehabilitation are included in current guidelines on rehabilitation after stroke, they do not specify the optimal content or timing of the information exchange on this sensitive topic. We aimed to identify factors that influence healthcare professionals' decision to initiate talks to inform on post-stroke sexual difficulties with patients or their partners.

**Methods:** Based on a PICO search strategy, we performed a systematic literature search in the following databases: PubMed, Psycinfo, Embase, and Cinahl in accordance with our PROSPERO protocol, (ID CRD42023418237). We included studies that investigated sexual rehabilitation post-stroke by health care professionals. To assess the risk of bias The Critical Appraisal Skill Program and Critical Appraisal Tools from Joanna Briggs Institute was used.

**Results:** We included sixteen studies, including a total of 616 patients (354 males and 262 females, age range 25-88), 33 partners (20 males and 13 females), and 411 healthcare professionals representing seven different professions. All subjects were either interviewed or completed a questionnaire on post-stroke sexual rehabilitation. Survivors of stroke expressed a need for information about poststroke sexual challenges whereas healthcare professionals felt they lacked knowledge of the issue, how to approach such talks and which profession was best suited in the context. Patients' wishes on timing and content of conversations with about sexual issues varied substantially.

**Conclusion:** Healthcare professionals require additional knowledge and experience to address sexuality among stroke survivors. The content and timing of sexual rehabilitation must be further clarified with patients and healthcare professionals.

## **Stenting of intracranial stenosis with the fibrin-heparin coated Credo Heal stent - Multicenter experience**

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**Introduction:** Mechanical thrombectomy (MT) has become the standard treatment for acute ischemic stroke due to large vessel occlusions (LVO). However, MT may not result in successful recanalization due to underlying stenosis and bail-out stenting may achieve permanent recanalization.

**Aim of Study:** To present the heal technology and the Credo heal Stent as an approach to intracranial atherosclerotic disease (ICAD) treatment and report the final results of a multicenter analysis.

**Methods:** We retrospectively analysed data from 16 stroke centres. Patients treated with the Credo heal Stent were divided into two groups: symptomatic intracranial stenosis (sICAD) and persisting LVO due to underlying stenosis after futile mechanical thrombectomy (Rescue Stenting group). Primary endpoints were improvement of stenosis grade and rate of successful recanalization. Favourable neurological outcome was defined by modified Rankin Score at 90 days.

**Results:** 121 patients were treated from 2021-2023 with the CREDO heal Stent. Rescue stenting and sICAD treatment was performed in 82 and 39 cases respectively. Overall, a final TICI  $\geq 2b$  score was achieved in 94.5%. In 14% periprocedural complications occurred where in-stent thrombosis accounted for 6.3% (rescue stenting group). The mean stenosis grade in the sICAD group was 90% before and 15% after PTA and stenting. On follow-up (n=27) restenosis was observed in 2.8%.

**Conclusion:** The Credo heal stent offers a treatment option for patients with sICAD or with persistent occlusion. The rate of restenosis is low compared to previous trials. Its effectiveness with regard to long-term ischemic complications will be evaluated in the prospective ReCHRUT trial.

**20-year mortality after early-onset ischemic stroke: the Helsinki young stroke registry**

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**Background and aims:** Ischemic stroke (IS) is one of the leading causes of death and disability worldwide. Around 10% of all ISs affect young adults. Young patients typically have many years of active lives ahead and therefore their long-term outcome after IS is important, but still understudied. We aimed to explore the cumulative 20-year risk of death in the Helsinki Young Stroke Registry, stratified by gender and stroke etiology.

**Methods:** Patients aged 15-49 years with a first-ever IS occurring between 1994-2007 were included into the Helsinki Young Stroke Registry. In this retrospective cohort study, data on mortality were searched from the Statistics Finland until the end of 2020. Baseline stroke etiology was classified with Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification. Cumulative 20-year risk for all-cause mortality was analyzed with life tables and adjusted risks were based on Cox proportional hazard analyses adjusted for age, gender, dyslipidemia, hypertension, current smoking, migraine, NIHSS, and lesion size.

**Results:** A total of 970 patients were included (median age 44 years, interquartile range 37-47, 37% women), of which 261 (26.9%) died during the median follow-up time of 17.8 years. The 20-year cumulative risk for death was 43% (95% confidence interval [CI] 37.2-48.8%) for men and 31.0% (95% CI 23.8-38.1%) for women. Compared to women, men had a non-significantly higher risk for death (hazard risk [HR] 1.3; 95% CI 0.9-1.8). The cumulative risk for death was highest in patients with small-vessel disease (SVD) (62.6%; 49.5-74.9%) and lowest in patients with stroke caused by low-risk cardioembolism (11.3%; -0.5-23.0%). Compared to stroke of undetermined cause, SVD carried a significantly higher risk for death (HR 2.0; 1.4-3.0), while the risk was significantly lower in low risk causes of cardioembolism (HR 0.3; 0.1-0.8).

**Conclusions:** Young IS patients have a high risk for all-cause mortality especially depending on stroke etiology, being highest in small-vessel disease and lowest for patients with stroke due to low-risk causes of cardioembolism.

## **Anti-Beta-2-Glycoprotein I and Anti-Cardiolipin Antibodies are Associated with Early-Onset Cryptogenic Ischemic Stroke**

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**Background:** Previously undetected antiphospholipid antibodies (aPLs) may be associated with early-onset ischemic strokes, which initially appear without obvious cause, but prior studies conducted mostly over a decade ago have provided inconclusive results. Therefore, we studied the association between aPLs and early-onset cryptogenic ischemic stroke (CIS).

**Methods:** SECRETO is a multi-center case-control study enrolling patients aged 18-49 with imaging-positive acute CIS and stroke-free controls. Investigational blood samples were obtained from patients at baseline and 12 weeks, and from healthy controls at one time point.

Information on comorbidities and lifestyle factors were gathered using structured interviews.

**Results:** A total of 503 patients and 504 controls were analyzed. In binary logistic regression adjusted for age and sex, at either of the time points, positive results of anti-beta-2-glycoprotein I IgG (aB2GPI, positive >10 U/ml, n= 51/10 patients/controls) and anti-cardiolipin antibodies IgG (aCL, high titer >40 U/ml, n= 10/1, and low titer 10-40 U/ml, n= 47/16) were associated with CIS (odds ratio [OR] 6.56, 95% confidence interval [CI] 3.29-13.10; OR 12.03, 95% CI 1.53-94.45 and OR 3.67, 95% CI 2.05-6.58, respectively). There was no significant difference between presence of positive lupus anticoagulant (LA) compared to controls (n=47/48). However, 41.4% of abnormal LA results were regarded negative due to use of anticoagulant treatment at the time of patient sampling. Among CIS patients, there were more positive findings at 12 weeks for any aPL ( $p<0.001$ ) and aB2GPI ( $p<0.001$ ), as well as low titer results for any aPL ( $p=0.0023$ ) and aCL ( $p<0.001$ ) than at baseline. The number of patients with positive LA results decreased from baseline to 12 weeks ( $p<0.001$ ).

**Conclusions:** Elevated levels of aB2GPI (>10 U/ml) and aCL ( $\geq 10$  U/ml) were associated with early-onset CIS. Notably, after the acute phase, any deviations in aB2GPI or aCL increased, but LA had a reverse trend. We found no association between LA and CIS.

## Early and late mortality and causes of death after Cerebral Venous Thrombosis

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**Objective:** Contemporary studies have shown a steady decline in mortality after cerebral venous thrombosis (CVT), most likely due to improved therapy and identification of less severe cases. We examined mortality rates and current causes of death in CVT.

**Methods:** We used data from the International CVT Consortium and collected information of consecutive adult CVT patients of 14 centers from 13 countries. The patients were diagnosed between 1995 and 2021. Patients who were not independent (mRS >2) at the time of diagnosis were excluded. Death rates at multiple time points and causes of death within 30 days and between 31 days and one year were assessed.

**Results:** Data from 1525 patients with CVT were included. Median age was 40 years (IQR 29-53) and 70% of the patients were female. A total of 33 patients (2%) died within 7 days, 59 (4%) died within 30 days, 91 patients (6%) died within one year, while 32 (2%) patients died between 31 days and one year. The main cause of early death (between 0 and 30 days of diagnosis) was intracerebral hematoma (ICH) and cerebral herniation (n=31, 61%), followed by underlying malignant disease (n=9, 18%), and infection (n=3, 5%). The main cause of late death (between 31 days and 12 months) was underlying malignant disease (n=13, 41%), followed by late CVT complications/ICH/herniation (n=6, 19%) and infection (n=6, 19%).

**Conclusions:** In this large international study, early death occurred in 4% of patients with CVT. Most common cause of short-term mortality was cerebral herniation. At one-year, overall mortality was 6%, with majority of deaths caused by underlying malignant diseases, late CVT complications, and infections.

## **Stroke, myocardial infarction and mortality in type 2 diabetes: A nationwide comparative effectiveness study of GLP-1RA, SGLT2i and DPP-4i treatment**

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**Background and aims:** Cardiovascular outcome trials demonstrate that glucagon-like peptide-1 receptor agonists (GLP-1RA) and sodium-glucose cotransporter 2 inhibitors (SGLT2i) reduce the risk of major adverse cardio-vascular events in patients with type 2 diabetes (T2D) and cardiovascular disease, whereas dipeptidyl peptidase-4 inhibitors (DPP-4i) have not shown cardiovascular benefits. We investigated the risk of stroke (ischemic/hemorrhagic), myocardial infarction (MI) and all-cause mortality amongst T2D patients, who were new users of GLP-1RA, SGLT2i and DPP-4i.

**Materials and methods:** A nationwide population-based cohort study using high-quality medical registries.

**Study Population:** Patients with T2D who were new users of GLP-1RA, SGLT2i or DPP-4i in the period 2014-2020 in Denmark. Patients with prior stroke were excluded. Results were adjusted for age, sex, calendar year of initiation, socio-economic factors and co-morbidity.

**Results:** The study included: 19,999 new users of GLP-1RA; 24,702 of SGLT2i and 41,943 of DPP-4i. New users of GLP-1RA and SGLT2i had a lower incidence of stroke when compared to new users of DPP-4i, Adjusted hazard rate ratios (aHRR): 0.73 (0.56-0.96) and 0.77 (0.61-0.97), respectively. There was no difference in stroke incidence between the new users of SGLT2i versus GLP-1RA: aHRR 1.02 (0.77-1.37). New users of GLP-1RA showed similar rate of MI when compared to DPP-4i, aHRR 1.02 (0.77-1.34), whereas new users of SGLT2i compared to GLP-1RA and DPP-4i showed higher incidence of MI: aHRR: 1.32 (1.01-1.72) and 1.27 (1.01-1.59), respectively. Mortality within 365 days was lower in new users of GLP-1RA and SGLT2i compared to new users of DPP-4i, aHRR: 0.46 (0.38-0.57) and 0.39 (0.33-0.46). There was no difference between SGLT2i versus GLP-1RA: aHRR 0.91 (0.72-1.16).

**Conclusion:** New users of GLP-1RA and SGLT2i in T2D-patients with and without co-morbid cardiovascular disease were associated with reduced risk of stroke and mortality in comparison with new users of DPP-4i. A wider use of GLP-1RA and SGLT2i may be beneficial in terms of preventing stroke and mortality.

## **Self-perceived stress is associated with both non-dipping blood pressure and cryptogenic ischemic stroke in young adults**

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**Background:** We recently showed that non-dipping blood pressure (BP) is associated with cryptogenic ischemic stroke (CIS) in young adults. We performed further analyses to evaluate whether non-dipping BP is more likely an actual risk factor for or merely an effect of CIS and what factors, in addition to CIS, might cause non-dipping BP phenomenon.

**Methods:** We performed 24-hour ambulatory BP monitoring in a subset of consecutive CIS patients and stroke-free controls of the multicenter case-control study, SECRETO. Non-dipping BP was defined as systolic and/or diastolic BP decreasing  $\leq 10\%$  from daytime to nighttime. Binary logistic regression (BLR) was used to assess the associations of non-dipping BP and possible confounders with CIS. Confounders included age, sex, low education, physical inactivity, unhealthy diet, obesity, heavy alcohol use, smoking, hypertension, patent foramen ovale (PFO), self-reported obstructive sleep apnea, Perceived Stress Scale (PSS) score, and Pittsburgh Sleep Quality Index global score. Patients responded to questionnaires based on the pre-stroke situation. BLR was also used to assess the associations of the same confounders, CIS, and antihypertensive medication with non-dipping BP.

**Results:** Data were available for 110 patients (median age, 42.0 years [36.0–46.8]; 57.3% men) and 95 controls (41.8 years [34.4–46.4], 56.8% men). In fully adjusted BLR models, PFO, non-dipping BP, and PSS score were associated with CIS with odds ratios of 5.59 (95% confidence interval, 2.86–10.93), 2.26 (1.01–5.06), and 1.08 per point (1.02–1.13), respectively, whereas hypertension, PSS score, and age were associated with non-dipping BP with odds ratios of 2.67 (1.12–6.35), 1.07 per point (1.01–1.12), and 0.94 per year (0.89–0.99), respectively.

**Conclusions:** PSS score was associated with both non-dipping BP and CIS in fully adjusted BLR models. This suggests that stress is a risk factor for stroke in young adults and that non-dipping BP might be a mediator in this pathophysiological pathway. Furthermore, non-dipping BP might play a role in the pathophysiology between hypertension and CIS.

## **Mental health and returning to work after stroke among young stroke patients in Tartu, Estonia**

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**Background and aims:** The aim of the study was to evaluate the prevalence of post-stroke mental health problems among young patients in Estonia and to analyse their association with returning to work.

**Methods:** Estonian Young Stroke Registry is prospectively recruiting all consecutive ischemic stroke patients aged 18–54 in Tartu University Hospital. This study includes patients with index stroke between 01.01.2017 to 31.12.2021. The patients were followed up at 1–3 years after the stroke and were screened for depression and generalized anxiety disorder (GAD) using the Emotional State Questionnaire (EST-Q). Post-traumatic stress disorder (PTSD) was evaluated with PCL-5 (PTSD Checklist for DSM-5). Modified Rankin Scale (mRS) was assessed.

**Results:** Of the 165 patients included in this analysis, 57.1% were males and the median age was 47 (IQR 40–51). On follow up, the median mRS was 1 (IQR 0–2; range 0–4). The EST-Q indicated depression in 25.8% and GAD in 24.7%, while PCL-5 identified PTSD in 18.6% of patients. At least one of the disorders was present in 36.1% of the patients. Depression (10.5% vs 20.0%,  $p < 0.000$ ) and PTSD (14.9 vs 33.3,  $p = 0.025$ ) were more common among patients with mRS  $\geq 2$  compared to those with mRS 0–1, while no significant difference was found for GAD. Similarly, the mean scores for depression (5.6 vs 11.1) and PTSD (14.4 vs 25.9) were higher in the group with a mRS 2–4. In all, 56.1% of patients reported that their employment has changed after stroke (in type, in volume or as leaving employment) and this was notably more common in patients who screened positive for depression (81.9% vs 47.3%,  $p < 0.005$ ), GAD (78.1% vs 48.9%,  $p < 0.005$ ) or PTSD (87.5% vs 48.5%,  $p < 0.005$ ).

**Conclusions:** Screening tests found mental health conditions in 36% of young stroke patients. Depression and PTSD were more prevalent in patients with worse functional outcome. Patients with depression, GAD or PTSD were more likely to change their employment or quit the workforce following stroke.



## **May prenotification of FAST symptoms increase activation of stroke alert and shorten prehospital time – a retrospective cohort study**

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**Introduction:** Reduction of prehospital delay is crucial in order to increase the access to effective stroke treatment. The objective of this study is to analyse whether prehospital recognition of FAST (Facial-Arm-Speech-Time) symptoms are associated with the activation of prehospital stroke alert and with reduced time to admittance to hospital.

**Material and methods:** Patients with a final diagnosis of acute stroke admitted to Nordland Hospital Trust and Helgeland Hospital Trust from June 1st 2018 to May 31st 2019 were included in a retrospective study. We recorded documentation of stroke symptoms in files from the EMCC (Emergency Medical Communication Centre), and in medical records at admission to hospital. In addition, we recorded means of transport to hospital, activation of stroke alert and time from onset to hospital arrival. The association between documented FAST symptoms in the records, and prehospital time, and activation of stroke alert will be analyzed with logistic regression models.

**Results:** The preliminary results include 365 patients; 89.3 % with ischemic stroke, 9.9 % with intracerebral hemorrhage and 0.8 % unspecified stroke (3 patients). Of these, 56 % alerted the emergency number 113 as the first contact, 43 % the GP (General Practitioner) or OOH-services (out-of-hours service) and 1 % met directly at the hospital. One or more FAST symptoms were documented in 74.4 % of ambulance records and in 66.6 % of hospital records, respectively. Prehospital stroke alert was activated in 46.1 % of patients. Further analyses will be presented at the congress.

**Summary and implications:** The study will provide data concerning the prehospital identification of stroke symptoms in two municipalities in Northern Norway. The results may add knowledge to be applied in the development of education of EMCC and paramedics as regards identification of stroke patients.

## Recanalization therapies for acute ischemic stroke in 2 largest hospitals in Estonia: why the differences?

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**Background and aims:** Early recanalization therapies (RT) such as intravenous thrombolysis (IVT) and mechanical thrombectomy (MT) is the cornerstone of acute ischemic stroke (AIS) management. According to the Estonian Health Insurance Fund stroke quality indicators, differences exist for IVT and MT proportions between two largest hospitals in Estonia. The aim of our study was to analyze the causes for not performing RT in North-Estonia Medical Center (NEMC) and Tartu University Hospital (TUH).

**Methods:** Retrospective chart review for all AIS admitted to NEMC and TUH between 01.01.2022 to 30.06.2022 was performed. Data were analyzed according to standard and extended time-windows protocols for IVT ( $\leq 4.5$  hours and  $\leq 9$  hours) and MT ( $\leq 6$  hours and  $\leq 24$  hours).

**Results:** A total of 658 patients were hospitalized, of them 182 patients (53%; mean age 75.3 years, SD 12.3) from TUH and 210 patients (66%; mean age 73.9 years, SD 13.3) from NEMC did not receive RT and were included in the study. The mean NIHSS score on admission was 6.4 (SD 7.3) in NEMC and 7.3 (SD 6.9) in TUH ( $p=0.041$ ). Of them, 22 (12%) patients in TUH and 37 (18%) in NEMC arrived  $<4.5$  hours. Between 4.5-9 hours 18 (10%) patients arrived in TUH and 12 (6%) in NEMC. The main reason for not receiving IVT during the first 9 hours was non-disabling stroke in 35% and 47%, acute lesion on computed tomography in 25% and 18%, and concomitant oral anticoagulation in 23% and 18% of patients respectively in TUH and NEMC. The differences between the hospitals were statistically nonsignificant. Twenty-seven (15%) patients in TUH and 41 (20%) in NEMC arrived in 6 hours and 48 (27%) in TUH and 81 (39%) in NEMC arrived in 6-24 hours. For patients presenting within 24 hours, the reasons for not receiving MT were following: no large-vessel occlusion in 79% and 86%, acute lesion on CT in 16% and 7% of patients in TUH and NEMC, respectively.

**Conclusions:** Our study showed that the reasons for not receiving RT in both hospitals were without significant differences. Thus, treatment decisions in both hospitals are made following modern treatment guidelines.

## **Sex differences in the outcomes after mechanical thrombectomy and thrombolysis - Meta-analysis by the Stroke in Women Guideline Module**

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**Background and Aims:** Whether outcome of stroke patients treated with intravenous (IV) thrombolysis or mechanical thrombectomy may differ between women and men aged > 80 year, is unknown. Method. A systematic review and meta-analysis of studies from 4 databases on the effect of thrombectomy and thrombolysis in women and men was conducted. We assessed whether functional outcome (mRS) at 90 days, mortality, symptomatic intracranial haemorrhage (sICH), revascularization differed between men and women, specifically in those ≥80 years.

**Results:** The meta-analyses of mechanical thrombectomy showed no significant differences in the effect on mortality, revascularization, and sICH between women and men. There was significantly less mRS ≤2 in women compared to men (Odds Ratio (OR) 0.85, 95% CI 0.71-1.00, p=0.05) (17 studies involving 6,241 patients). Meta-analyses of IV thrombolysis showed a significant increase in mortality in women compared to men, OR 1.15, 95% CI 1.01-1.31, p=0.03 (21 studies involving 57,174 patients at 3 months); a significant decrease in mRS ≤2 in women compared to men, OR 0.78, 95% CI 0.71-0.86; p<0.001 (24 studies, involving 55,864 patients); but no significant difference in ICH between women and men. Meta-analysis of intraarterial thrombolysis showed no significant difference in mortality, mRS ≤2 and sICH between women and men. In patients aged ≥80 years, i) meta-analyses of thrombectomy showed no significant difference in mortality, mRS ≤3 and revascularization between women men; ii) meta-analyses of IV thrombolysis showed no significant difference in mortality and ICH between women and men aged, but a significantly less mRS ≤2 score in women compared to men, OR 0.52, 95% CI 0.29-0.91, p=0.02 (2 studies involving 252 patients).

**Conclusion:** The analysis showed no difference between men and women aged ≥80 years following thrombectomy, while there was less mRS ≤2 in women compared to men with IV thrombolysis.

## **Xanthine oxidase inhibition and white matter hyperintensity progression following ischaemic stroke and transient ischaemic attack in people with elevated serum uric acid levels**

Rida Hamandi, Jesse Dawson, Alan Cameron, Michele Robertson, David Alexander Dickie, Phillip Bath, Kirsten Forbes, Terence Quinn, Niall M. Broomfield, Krishna Dani, Alex Doney, Graeme Houston, Kennedy R. Lees, Keith W. Muir, Allan Struthers, Matthew Walters, Mark Barber, Ajay Bhalla, Alexander Dyker, Paul Guyler, Ahamad Hassan, Mark T. Kearney, Breffni Keegan, Sekaran Lakshmanan, Mary Joan Macleod, Marc Randall, Louise Shaw, Ganesh Subramanian, David Werring, Alex McConnachie

**Background:** Ischaemic stroke onset increases the risk for cognitive impairment, cardiovascular disease, and recurrent vascular events. Elevated serum uric acid (UA) levels are correlated with vascular cognitive decline, and increased risk of first and recurrent strokes. Allopurinol, a xanthine oxidase inhibitor, is a urate-lowering medication that has been shown in clinical trials to reduce carotid-intima media thickness progression and lower blood pressure in patients with ischaemic stroke. This study examined allopurinol's impact on white matter hyperintensity (WMH) progression and blood pressure following ischaemic stroke or transient ischaemic attack in individuals with elevated serum UA levels.

**Methods:** This prospective, placebo-controlled, double-blinded, multi-centered study was conducted in 22 stroke units in the United Kingdom. Participants were randomly assigned within 30 days of ischaemic stroke or TIA to receive oral allopurinol 300 mg twice daily or placebo for 104 weeks. MRI was performed at baseline and week 104, along with ambulatory blood pressure monitoring at baseline, week 4, and week 104. WMH Rotterdam Progression Score (RPS) was the primary outcome of this study, and it was measured at week 104. Serum UA levels were measured at week 4 and week 104, with hyperuricemia being defined as a serum UA value of 360  $\mu\text{mol/L}$ . Analyses were by intention to treat. This trial is registered with ClinicalTrials.gov, NCT02122718.

**Findings:** Between 25th May 2015 and 29th November 2018, 464 participants were enrolled (232 per group). Hyperuricemic placebo and allopurinol participants who attended for week 104 MRI totaled 46 and 51 respectively and were included in the analysis of the primary outcome. The RPS at week 104 was 1.2 (SD 1.8) with allopurinol and 1.4 (SD 1.7) with placebo (between-group difference  $-0.15$ , 95% CI  $-0.87$  to  $0.55$ ,  $p = 0.66$ ).

**Interpretation:** Allopurinol use did not reduce WMH progression in hyperuricemic people with recent ischaemic stroke or TIA.

**Optimizing the density and locations of thrombectomy centers and HEMS helicopters in regard to the cost-effectiveness of endovascular treatment modalities**

Nicklas Ennab Vogel<sup>1</sup>, Per Wester<sup>2,3</sup>, Tobias Andersson Granberg<sup>1</sup>, Lars-Åke Levin<sup>1</sup>

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Owing to its crucial role in curbing mortality and functional disability, whilst improving the likelihood for good clinical outcomes, mechanical thrombectomy (MT) has emerged as standard of care in the acute treatment of patients with acute ischaemic stroke (AIS) due to anterior circulation large vessel occlusion (LVO). Despite the rapid development of next-generation stent retrievers and large bore aspiration catheters that improve reperfusion rates, and the extended time window from 6 up to 24 hours from symptom onset in highly selected, small proportion of patients, efforts to reduce the time from symptom onset to treatment start is still critically important for improving functional outcomes in patients treated with IVT and/or MT. Prevailing issues of in-accessibility to and under-utilization of MT on the level of national, state or regional stroke systems of care, can be addressed by increasing the number of comprehensive stroke centers (CSCs), thrombectomy-capable stroke centers (TSCs) and/or HEMS helicopters. We show that it is possible to determine the optimal number and locations of C-/TSCs and HEMS helicopters, respectively within acute stroke systems of care in regard to the cost-effectiveness of endovascular treatment modalities.

## **Abstracts for Posters**

(in descending order of arrangement in the program)

**No.1.****Pleocytosis in cerebrospinal fluid attributed to ischemic stroke: A review of the literature**Lucas Ivan Sebastian Rundblad<sup>1</sup>, Helle K. Iversen<sup>1,2</sup>, [Anders S. West](#)<sup>1</sup><sup>1</sup>*Department of Neurology, Clinical Stroke Research Unit, Rigshospitalet, Denmark;* <sup>2</sup>*Faculty of Health Sciences, University of Copenhagen, Denmark*

**Introduction:** Lumbar puncture is generally performed in stroke settings when infectious or inflammatory diseases are suspected to be the etiology. This review aimed to assess the prevalence of pleocytosis in the cerebrospinal fluid following ischemic stroke without inflammatory or infectious etiology.

**Methods:** We searched PubMed for studies with mentions of “[ischemic stroke] AND [cerebrospinal fluid]”. We included only studies written in English, including patients with a primary diagnosis of either ischemic stroke or transient ischemic attack (TIA), and where white blood cell count in the spinal fluid was presented. Studies investigating common etiologies for pleocytosis were excluded. Study and patient characteristics, white blood cell count, and time to lumbar puncture were presented in tables, and the prevalence of pleocytosis was reported and plotted graphically.

**Results:** We included 15 studies with 1607 patients, 1522 with ischemic stroke, and 85 with TIA. The prevalence of pleocytosis was between 0% to 28,6% and a mean of 11.8%. The highest white blood cell count found with common etiologies for pleocytosis ruled out was 56 cells/mm<sup>3</sup>. A mean white blood cell count of 4.0 was based on the three studies where this was available.

**Discussion:** The included studies were methodologically heterogeneous and few had pleocytosis as primary outcome. Pleocytosis following ischemic stroke is uncommon and should prompt further investigations.

**No. 2.****Circadian rhythm and the influence of light on parameters related to calcium metabolism in stroke patients admitted for rehabilitation**

Shanga H. Qadir<sup>1</sup>, Helle K. Iversen<sup>1,2</sup>, Niklas R. Jørgensen<sup>2,3</sup>, Poul J. Jennum<sup>4</sup>, Henriette P. Sennels<sup>5</sup>, Anders S. West<sup>1</sup>

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**Background and aims:** Stroke patients admitted for rehabilitation are at risk of developing circadian disruption due to the lack of sunlight and exposure to artificial hospital light at inappropriate times. In healthy subjects, parameters related to calcium metabolism follow a circadian rhythm. This rhythm may be affected following moderate to severe stroke. We aimed to investigate the circadian rhythm and the influence of naturalistic light (imitating the sunlight rhythm) on parameters related to calcium metabolism in stroke patients under admission for neurorehabilitation.

**Methods:** A secondary explorative analysis from a Randomized Controlled Trial. Acute stroke patients requiring a minimum of 2 weeks of rehabilitation were randomized to an intervention unit (IU) equipped with naturalistic light or a control unit (CU) with standard indoor lighting. Blood was drawn across 24 hours with 4-hour intervals at both inclusion and discharge. Circadian rhythmicity was estimated using cosinor analysis and variance analysis between time points.

**Results:** A total of 42 patients, 22 from the IU and 20 from the CU, completed the blood collection. Serum calcium exhibited significant cosinor rhythmicity at inclusion and discharge in both patient groups ( $p > 0.0001$ ). Serum phosphate showed significant cosinor rhythmicity at discharge in the CU. Whereas serum measurements of Alkaline phosphatase, Parathyroid Hormone (PTH), and Vitamin D failed to exhibit significant rhythmicity at inclusion and discharge in both groups. Moreover, out of the parameters, only PTH did not show significant variations calculated by variations analysis between time points.

**Conclusions:** These results indicate an absence of normal circadian rhythmicity in parameters related to calcium metabolism after stroke compared to what is known in healthy individuals. Naturalistic light did not have any significant influence, indicating that light may not be the main circadian regulator of the circadian oscillations that regulate calcium metabolism. Further studies should elaborate on this.



**No. 3.****Rehabilitation pathways after discharge from comprehensive stroke unit impact on the level of functional outcome**

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**Background and Purpose:** Length of stay at a stroke unit after a stroke is short and referral to in- or outpatient rehabilitation after discharge may be needed to facilitate recovery. There is a knowledge gap regarding the impact of different pathways after discharge from stroke unit to functional outcome. The primary aim of this study was to investigate how referral to different types of rehabilitation at discharge from Swedish stroke units' impact at the functional outcome 1- and 5 years after stroke. The secondary aim was to investigate the change of functional outcome between these timepoints.

**Methods:** This longitudinal and register-based study with a sample of 5,118 participants affected by stroke during 2011 analyzed functional level after 1 and 5 years. Ordinal logistic regression models were fitted to predict functional outcome; the outcome variable had three categories: independent, dependent, and dead.

**Results:** Data from 5118 participants were analyzed, and the average age was 76 years in median (IQR 16), 56 % were males and 90.1 % were alert at admission to hospital. One year after stroke planned rehabilitation in home setting was associated with higher odds for independency compared to death (OR: 1.27 95% CI 1.03-1.57) and to dependency compared to death (OR: 1.68 95% CI 1.30-2.18). After 5 years, planned rehabilitation in home setting was still associated with higher odds for independency compared to death, (OR 1.16 95% CI 0.94-1.43), and to dependency compared to death (OR 1.37 95% CI 1.12-1.69). Low odds for independency compared to death after 1 year and 5 years were observed for participants planned for inpatient rehabilitation.

**Conclusions:** Independency 1 and 5 years after stroke was predicted by planned rehabilitation in home setting or outpatient rehabilitation when adjusting for confounding factors. Our results imply that functional outcome after these types of rehabilitation are satisfactory responding to the functional objectives of rehabilitation after stroke.

**No. 4.****A short Swedish version of the Montreal Cognitive Assessment**

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**Background and aims:** The international guidelines recommend cognitive screening of patients admitted to stroke units, and brief screening tools are preferred. The primary objective of this study was to develop a short-form Montreal Cognitive Assessment (MoCA) Swedish Version (s-MoCA-SWE) for use in patients with stroke. The secondary objectives were to identify an optimal cutoff value for the s-MoCA-SWE to screen for cognitive impairments and to compare the sensitivity of the s-MoCA-SWE with previously developed short forms of the MoCA.

**Methods:** This cross-sectional study included patients admitted to the stroke and rehabilitation units in hospitals across Sweden. Cognition was screened using the MoCA (range 2 – 14 days after onset of stroke). Supervised and unsupervised algorithms were used to develop working versions of the s-MoCA-SWE. The final version of the s-MoCA-SWE was chosen based on its sensitivity and positive predictive value for detecting patients with cognitive impairments.

**Results:** Data from 3276 patients were analyzed (40% female, mean age 71.5 years, 56% minor stroke at admission). The s-MoCA-SWE suggested in this study comprised the following items: delayed recall, visuospatial/executive function, serial 7, fluency, and abstraction. The aggregated scores ranged from 0 to 16. A threshold for impaired cognition  $\leq 12$  had a sensitivity of 97.3 (95% confidence interval [CI]:96.5-97.9) and positive predictive value of 89.9 (95%CI:88.8-90.9).

**Conclusions:** Our s-MoCA-SWE with a threshold of  $\leq 12$  can detect post stroke cognitive issues. Therefore, it can be used as a rapid cognitive testing tool in stroke units.

**No. 5.****Preventing falls in Neurology unit in Acute Care Hospital**

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**Background and aims:** Falls in the hospital are adverse events that cause pain, increased treatment days and costs each year. Over 90% of hip fractures are caused by falls and are the main cause of accidental brain injuries in Finland. Fall prevention is effective compared to the cost of falls. The World guidelines for falls prevention and management (Montero-Odasso et al. 2022) recommends a tailored education on falls prevention and personalized single or multidomain falls prevention strategies to all hospitalised older adults and other high-risk groups. Fall T.I.P.S. model is evidence-based method for reducing falls in hospitals. The aim is to prevent patient falls in hospital. The purpose is to use Fall T.I.P.S. model to prevent falls in Neurological unit. The task was to examine the impact of the introduction of a Fall T.I.P.S. model and artificial intelligence (AI) technology in camera surveillance on the prevention of falls in Neurological unit.

**Method:** In the Neurology Department of the Kuopio University Hospital, the fall risk assessment is used for each patient, supplemented by the Fall T.I.P.S. model. When the patient is at an increased risk of falling and he/she has cognitive challenge, a camera tracking system based on artificial intelligence is used to prevent falls. The system informs the nurse's mobile device of the patient's movements in accordance with the specified settings, so that the nurse has time to visit the patient even before mobilization.

**Results:** The fall prevention has reduced falls. Over the period from 2020 to 2022, the falls of Neuro Centre wards has decreased by 57% (falls in 2020 3.1/1000 patient days, 2022 1.32/1000 patient days). The human activity detection and AI technology produces day-to-day information about how the system is used. The prevention of falls has become part of daily care.

**Conclusions:** To have the optimal outcome from AI technology in camera surveillance on the prevention of falls, it is crucial to use the fall risk assessment tool. Regarding the fall risk assessment AI technology in camera surveillance provides useful intervention which can be noticed in effectiveness in care.

**No. 6.****Neurologist-oriented screening of atrial fibrillation with implantable loop recorder in patients with cryptogenic stroke**

Olli P. Suomalainen, Sami Pakarinen, Silja Rätty, Jenna Broman, Henrietta Törmänen, Karoliina, Aarnio, Satu Kivelä, Jarkko Karvonen, Pekka Raatikainen, Jukka Putaala

**Introduction:** Atrial fibrillation (AF) is one of the strongest risk factors for ischemic stroke (IS). In one-third of patients, the stroke etiology remains cryptogenic, but an embolic source is suspected (embolic source of undetermined source, ESUS). For ESUS patients, prolonged monitoring may improve detection of occult AF. We aimed to study the incidence of occult atrial fibrillation with implantable loop recorder (ILR) among patients with cryptogenic stroke.

**Materials and Methods:** All patients fulfilling the ESUS criteria and with implanted ILR at the Helsinki University Hospital from August 2019 to March 2023 were included. Abbot Confirm Rx™ ILR device was implanted in all patients at the neurology outpatient clinic. Included patients had no contraindication for anticoagulation treatment (CHA<sub>2</sub>DS<sub>2</sub>-VASc ≥3, stroke and one other risk factor) and at least 1 additional factor; frequent supraventricular extrasystole or tachycardia in prescreening ambulatory electrocardiogram (ECG) or telemetry, P-on-T or P-terminal force on ECG, dilated left atrium (diameter > 40 mm) or abnormal natriuretic peptide (proBNP)-level. Time interval >30 s was required for definitive diagnosis of AF.

**Results:** Altogether 72 patients were included into the study (mean age 70 ±11 years; 51% male), of which 66 (92%) had definitive ESUS-type stroke. Median time from stroke onset to implantation of ILR was 117 days (IQR 71-181). Among ESUS patients with completed ILR monitoring (2 years or one year after AF diagnosis), new AF was detected in 16/30 (53%). In 36/72 (50%) patients, ILR monitoring is still ongoing. Median delay from ILR implantation to AF diagnosis was 59 days (IQR 21-186) although in 3 patients AF was detected within 10 days since ILR implantation. In patients with AF detected, median number of transmissions before first AF episode was 3 (IQR 0-24). Number of all transmissions in ESUS patients was 1199 (n=75/new AF). All patients with new AF initiated oral anticoagulation. The most common additional patient selection factor indicating heightened AF risk was frequent supraventricular extrasystole in the pre-implantation ECG screen: 12/16 (75%) of all AF patients.

**Conclusion:** Neurologist-oriented screening of AF with ILR in collaboration with cardiologists in ESUS patients is feasible and results in a high AF detection rate when patients are carefully selected.

**No. 7.****Virtual Motor Spaces: Exploring how to amplify movements in virtual reality stroke rehabilitation to aid patients with upper limb hemiparesis**

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Upper limb (UL) hemiparesis and spatial neglect are common impairments after stroke. Around 50 percent of patients with stroke suffer from impaired UL motor function, one-third experience severe impairment. Unilateral spatial neglect (USN) is prevalent in 23–46% of stroke survivors. Both conditions frequently occur together, which has a detrimental influence on recovery and the ability to perform activities of daily living. Virtual Reality (VR) training systems may provide a unique opportunity to combine training for USN and UL impairment and at the same time allow for individualized assessment and treatment. However, the varying severity of upper limb hemiparesis provides challenges for the design of player input control in VR rehabilitation systems. We designed virtual motor spaces as a novel input method in VR which amplify limited hand movement for a Whack-A-Mole game. The virtual motor space consisted of a two-dimensional world-locked rectangular area, which enabled control of a cursor on the Whack-A-Mole wall when the user's controller moves within its boundaries. The virtual motor spaces in Whack-A-Mole VR were designed and implemented for seated VR gameplay, from e.g., a wheelchair. The virtual motor space dimensions supported three prefixed sizes of small (7.5 cm x 5 cm), medium (30 cm x 20 cm), or large (60 cm x 40 cm), to allow for rigid comparison of movement data. The motor space dimensions could also be altered through a custom calibration, which let players draw the outer boundaries of their own motor range in VR. The leftmost, right-most, upper, and lower boundaries of the Whack-A-Mole wall became mapped to the motor space boundaries. Results from an initial pilot study including 14 healthy volunteers showed that participants were able to reach the same number of targets in the same amount of time. The virtual motor spaces aim to facilitate rehabilitation and for neuropsychological comparison of patient performance despite differing severity of hemiparesis. Future studies will measure how well motor spaces allow for the adaption of Whack-A-Mole for stroke patients with UL impairment or USN.

**No. 8.****Posterior circulation stroke patients - why don't they get reperfusion therapy?**

Aleksandra Ekkert, Une Jokimaityte, Dalius Jatužis

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**Introduction:** Posterior circulation strokes (PCS) present with typical symptoms less frequently, making them difficult to recognise. PCS patients are at risk of belated arrival. In hospital, they are managed slower, get reperfusion therapy (RT) later and less frequently than those with anterior circulation stroke. The aim of our study was to analyse factors influencing the suitability for RT in PCS.

**Methods:** We retrospectively analysed clinical and demographical data of 500 PCS subjects admitted to Vilnius University Hospital Santaros Klinikos in 2018-2020. 3 groups were distinguished: those who got RT (RT group), no RT due to absolute contraindications (ACI group), and no RT due to relative contraindications (RCI group).

**Results:** 202(40.3%) were female, median age 69(18) years, median NIHSS on admission 4(4). 372(74.4%) were FAST+, 487(97.4%) BEFAST+. RT group (120(24%) subjects) had higher NIHSS than non-RT groups (7 vs 3,  $p<0.001$ ), higher prevalence of FAST+ (112(92.6%) vs 260(68.6%),  $p<0.001$ ) and BEFAST+ subjects (120(100%) vs 366(96.6%),  $p=0.039$ ). Being FAST+ (OR=5.62, 95%CI[2.90 – 12.28]), higher NIHSS score (OR=1.13 for each point, 95%CI[1.09 – 1.18]), history of AF (OR=1.56, 95%CI[1.02 – 2.38]), AH (OR=2.19, 95%CI[1.17 – 4.53]) and DM (OR=1.70, 95%CI[1.06 – 2.71]) increased the chance of RT. 330(66%) subjects were in the ACI group, mostly due to belated arrival – 291(58.2%). The risk of being late was higher in FAST-negative subjects (OR=2.92, 95%CI[1.84 – 4.77]) and males (OR=1.58, 95%CI[1.11–2.28]), and lower in subjects with higher NIHSS scores (OR=0.88, 95%CI[0.85–0.92]). In the RCI group (50(10%) subjects), age>80 and NIHSS≤5 were the most frequent RCI. Nevertheless, some subjects with the same RCI got the RT. Those subjects had higher median NIHSS (4 vs 3,  $p<0.001$ ), and higher prevalence of AH (59(92.2%) vs 35(77.8%),  $p=0.032$ ) and HF (23 (35.9%) vs 7 (15.6%),  $p=0.018$ ). There was a trend for lower female prevalence in the RT group who had the RCI (57.8% vs 39.1%,  $p=0.054$ ).

**Conclusion:** The most frequent obstacle to getting RT was belated arrival – possibly, because stroke symptoms were under-recognised. Being FAST+ and having higher NIHSS increased the chance of getting RT. That means that there is a need to inform society and clinicians about BEFAST+ symptoms. Despite having the same RCI, some subjects got RT. Subjects with vascular risk factors were treated with RT more frequently, possibly, because they made clinicians more vigilant for stroke. Although men were late for RT more frequently, there was a trend to withhold RT in women with RCI. These findings illustrate the subjectivity of the decision-making process.

**No. 9.****Sex-related differences in baseline characteristics and risk factors in young-onset cryptogenic ischemic stroke**

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**Background and aims:** It is not yet known whether sex plays a role in young-onset cryptogenic ischemic stroke (CIS). We hypothesized that sex affects the presentation and risk factor profile of young-onset CIS. In the multicenter SECRETO Study (Searching for Explanations for Cryptogenic Stroke in the Young: Revealing the Etiology, Triggers, and Outcome) we aimed to assess the baseline comorbidities, risk factors, and symptomatology between genders in patients with first-ever young-onset CIS.

**Methods:** Patients with CIS at age 18-49 were prospectively enrolled in the SECRETO study between November 2013 and January 2022, and underwent comprehensive, standardized and timely etiological investigations. We compared demographics, risk factors, premonitory symptoms, and the prevalence of patent foramen ovale (PFO) between men and women.

**Results:** Among the included 509 patients, median age was 41 years, 47% were women. Median admission NIH Stroke Scale [NIHSS] score was 2 (range 0-20), and 22.4% were treated with IV-thrombolysis and 9.0% with thrombectomy. Compared to men, women were younger (median age 39 vs. 42 years;  $P=0.002$ ) and had more frequently any type of migraine (53.8% vs. 37.5%;  $P<0.001$ ), especially migraine with aura (45.4% vs. 28.8%;  $P<0.001$ ). Women also had non-significantly higher median NIHSS on admission (3.7 vs. 2.8;  $P=0.055$ ). In contrast, men were more often current smokers (29.8% vs 38.3%;  $P=0.036$ ), obese (41.0% vs. 74.2%;  $P<0.001$ ), had unhealthier diet (mean score 26 vs. 24;  $P<0.001$ , higher score indicating healthier diet), and more frequently hypertensive (34.0% vs. 41.1%;  $P=0.083$ , nonsignificant). There were no differences in other risk factors, presence of PFO, in pre-stroke symptoms nor type of stroke onset.

**Conclusions:** Men seem to harvest traditional risk factors more frequently compared to women, whereas migraine was the prevailing risk factor among women. Notably, many of the risk factors frequent in men could be eliminated with more intensive life-style interventions.

**No. 10.****Transportation directly to the comprehensive stroke center could provide time-benefit to patients with large vessel occlusion**

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**Background:** In acute ischemic stroke, a delay in treatment can significantly affect the prognosis. Patients with large vessel occlusion (LVO) may benefit from intra-arterial mechanical treatment. However, treatment is only available at comprehensive stroke centers (CSCs). It is therefore important to identify factors that could reduce logistical delays related to patient transport.

**Methods:** We analyzed the time labels of transportation of acute ischemic stroke patients who went through intra-arterial mechanical treatment in Kuopio University hospital between years 2015-2016. We used a simulation model to investigate the potential time benefit if the patient had been transported directly to CSC by ambulance or helicopter compared to those transported first to the primary stroke center (PSC) before transportation to CSC.

**Results:** For 122 patients, the mean time delay from the activation of emergency medical service to arrival at CSC was 119 minutes (IQR 71-217). In the simulated model, the mean time delay by ambulance would have been 106 minutes (IQR 71-131) and by helicopter 83 minutes (IQR 57-100). 17 patients transported by ambulance and 25 by helicopter would have benefited from direct transport to CSC for more than two hours.

**Conclusions:** In acute ischemic stroke, transportation is a very important factor in time delays. Direct transport of patients to CSC would reduce delays in initiating intra-arterial mechanical treatment in patients with LVO. Some patients would benefit from transport by helicopter emergency medical service.



**No. 11.****Transient ischemic attack – a warning sign of ischemic stroke**

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**Introduction:** Every year, 3.3 million people die, and 63 million years of healthy life are lost due to ischemic stroke (IS) worldwide. Transient ischemic attack (TIA) indicates the risen risk of IS: 10–20 % of patients with first-ever TIA have an IS within 3 months after TIA. During decades, the incidence of IS has declined globally, as well as in Finnish population. However, the incidence of TIA has never been reported in Finland. In this study, we investigate the TIA incidence in Eastern Finnish population.

**Methods:** Every patient with a suspected TIA in Northern Savonia area with population of 246,653 inhabitants in 2017 are referred to Kuopio University Hospital (KUH). The patients with a suspected TIA (n=432) referred to KUH in 2017 comprised the original study population. Data were collected from patient data system of KUH. SPSS 27.0 (IBM) was used in analyses.

**Results:** From 432 patients with a suspected TIA, 29 patients were living in another hospital district, 56 had TGA, and 54 patients had any other diagnosis than TIA. 293 patients had TIA as the final diagnosis, and 211 patients had first-ever TIA. The crude incidence of first-ever TIA was 86/100,000, and age-standardized (European population 2010) incidence was 64/100,000. Women were significantly older than men (72 vs. 68 years) when having first-ever TIA. Hypertensive disease, coronary artery disease, and type 2 diabetes were the most common previous diseases in first-ever TIA patients.

**Conclusion:** Compared to previous European studies, this study showed high incidence of TIA in Eastern Finnish population. TIA diagnoses were made using the WHO criteria of TIA mostly due to limited availability of magnetic resonance imaging in our unit, which may lead to overestimation of the incidence rate. However, considering that some patients may not seek medical attention with transient symptoms, TIA incidence is most likely not overestimated in this study. Further research is needed to increase our knowledge of incidence trends and prognosis of TIA.

**No. 12.****Initiation of antipsychotics and ischemic stroke in young adults**

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**Introduction:** Neuropsychiatric symptoms and complications after stroke affect approximately one third of the patients and may have a negative effect on the recovery. Post-stroke psychotic symptoms are rare but reported to be associated with increased long-term mortality. However, data on psycholeptics started after ischemic stroke (IS) is scarce. We aimed to characterize young patients initiating antipsychotics within a year after IS and examine factors associated with the post-stroke initiation.

**Methods:** The Helsinki Young Stroke Registry (HYSR) includes 1008 patients aged 15–49 with first-ever IS between 1994 and 2007. Data originated from the nationwide registers. Filled prescription for antipsychotics within a year from IS was considered as initiation of antipsychotics. Cox regression models allowed assessing baseline factors associated with the initiation, adjusting for age, sex, and factors with a  $p < 0.05$  in univariable comparison. By using backwards stepwise selection, the final model included age, sex, socioeconomic status, and history of psychiatric hospitalization.

**Results:** The study included 937 patients with median age 44 (IQR 37–47), 62.4% male (those with false primary diagnosis, could not be linked to database, dying during 3 weeks from IS, or purchased antipsychotics within a year prior IS were excluded). Of these, 29 (3.1%) initiated antipsychotics within a year after IS. Compared to patients without initiation of antipsychotics, initiators were less often white-collar workers (10.7% vs. 37.9%) and had more often other/unknown socioeconomic status (42.9% vs. 20.5%). They were more often smokers (65.6% vs. 43.3%) and heavy alcohol users (31.0% vs. 12.7%) and had more often history of psychiatric hospitalization (24.1% vs. 4.8%). In univariable analysis, current smoking (hazard ratio 2.44, 95% confidence interval 1.13–5.24), heavy alcohol use (3.01, 1.37–6.60), and history of psychiatric hospitalization (5.85, 2.50–13.7) were associated with higher hazard of initiating antipsychotics within a year from IS. In multivariable analysis, this association remained for history of psychiatric hospitalization (3.66, 1.50–9.24).

**Conclusions:** History of psychiatric hospitalization was independently associated with initiation of antipsychotics after IS in young adults, pointing out to reactivation of psychotic symptoms with a need for reinstatement of medical therapy.

**No. 13.****Predicting post stroke cognitive impairment**

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**Background and aims:** Stroke increases the risk of cognitive impairment and dementia. Cognitive decline may be present prior to stroke and accelerate after stroke due to underlying vascular dysfunction. This study aims to investigate whether information on pre-stroke cognitive function can be used to predict which patients will develop post stroke cognitive impairment (PSCI) or post stroke dementia (PSD) and whether this information is better than cognitive screening during acute admission to predict PSCI and PSD.

**Method:** This study uses data from the Exploring Vascular Contributions to Cognitive Impairment and Dementia (ENIGMA) project, an ongoing prospective cohort study including patients with acute ischemic stroke. At baseline, cognition is assessed using the Montreal Cognitive Assessment (MoCA) and pre-stroke cognitive decline is assessed using the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), where a score above 48 indicates decline. The cognitive outcomes are assessed using MoCA and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). Dementia is defined as two RBANS domain scores <70.

**Results:** Data collection is ongoing, so results are preliminary. Patients who fulfilled the dementia criteria (n=11) had a median IQCODE score of 54 (IQR 51.5, 57.5), whereas patients who did not (n=32), had median score 49 (IQR 48.0, 53.0). The IQCODE score difference between patients who fulfilled the dementia criteria and patients who did not, was significant (p-value 0.014). Linear regression analyses showed an association between cognitive decline at baseline (high IQCODE score and low MoCA score) and cognitive decline at follow-up (low RBANS score). Finally, the results suggested low MoCA score at baseline was more strongly associated with cognitive impairment than IQCODE.

**Conclusion:** The preliminary results suggest that pre-stroke cognitive decline, measured on the IQCODE, was associated with greater risk of fulfilling the dementia criteria 12 months after stroke. The results suggest an association between baseline cognitive test results and follow-up results and that MoCA test is better at identifying patients at risk of cognitive impairment than IQCODE. Finally, we plan to investigate whether IQCODE score is more useful in predicting cognitive decline in patients with small vessel disease, when data is complete.

**No. 14.****Diet-induced weight loss in obese/diabetic mice normalizes glucose metabolism and promotes functional recovery after stroke**

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**Background:** Post-stroke functional recovery is severely impaired by type 2 diabetes (T2D). This is an important clinical problem since T2D is one of the most common diseases. Because weight loss-based strategies have been shown to decrease stroke risk in people with T2D, we aimed to investigate whether diet-induced weight loss can also improve post-stroke functional recovery and identify some of the underlying mechanisms.

**Methods:** T2D/obesity was induced by 6 months of high-fat diet (HFD). Weight loss was achieved by a short- or long-term dietary change, replacing HFD with standard diet for 2 or 4 months, respectively. Stroke was induced by middle cerebral artery occlusion and post-stroke recovery was assessed by sensorimotor tests. Mechanisms involved in neurovascular damage in the post-stroke recovery phase, i.e., neuroinflammation, impaired angiogenesis and cellular atrophy of GABAergic parvalbumin (PV)+ interneurons were assessed by immunohistochemistry/quantitative microscopy.

**Results:** Both short- and long-term dietary change led to similar weight loss. However, only the latter enhanced functional recovery after stroke. This effect was associated with pre-stroke normalization of fasting glucose and insulin resistance, and with the reduction of T2D-induced cellular atrophy of PV+ interneurons. Moreover, stroke recovery was associated with decreased T2D-induced neuroinflammation and reduced astrocyte reactivity in the contralateral striatum.

**Conclusion:** The global diabetes epidemic will dramatically increase the number of people in need of post-stroke treatment and care. Our results suggest that diet-induced weight loss leading to pre-stroke normalization of glucose metabolism has great potential to reduce the sequelae of stroke in the diabetic population.

**No. 15.****Nanoencapsulated neuroglobin activates neurogenesis after ischemic stroke**

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Ischemic stroke is one of the main causes of death and disability in the world. However, at present, there are no efficient preventive and/or palliative treatments. Neuroglobin (Ngb) is an endogenous protein that has been proven to exert neuroprotective roles against stroke. These are related to its capacity to diminish the reactive oxygen and nitrogen species as well as to its involvement in the mitochondrial function and apoptosis. However, the role of Ngb in neurogenesis has been scarcely analyzed. The basal levels of this protein do not guarantee protection against neuronal death after ischemia, and only its overexpression yields this effect. Hence, the pharmacologic administration of Ngb may constitute an efficient therapy for stroke and other neurodegenerative pathologies, although its inability to cross the blood-brain barrier (BBB) makes unfeasible its direct use as a systemic drug. Our research group has overcome this problem by adding recombinant Ngb to nanovehicles (NPs). Thus, these Ngb-loaded NPs (Ngb-NPs) administrated by intravenous injection immediately at the onset of the reperfusion period, effectively cross the BBB and increase the bioavailability of Ngb in the neurons within the cerebral infarcted area of rats submitted to a tMCAO model of stroke. In order to explore the potential neuro-regenerative capacity of our pharmaceutical preparation, we have studied the in situ expression of doublecortin (DCX), a microtubule-stabilizing protein expressed by neuronal precursor cells and immature neurons, by means of immunohistochemistry techniques. The analysis, carried out after 24 hours and 7 days of reperfusion, involved the hippocampus, parietal cortex and striatum of rats from three experimental groups: sham, tMCAO animals injected with empty-NPs and tMCAO rats treated with Ngb-NPs. The results indicated a scarce but similar immunostaining pattern in the different brain zones of animals from the three experimental groups after 24 hours post-surgery. However, the administration of Ngb-NPs increased the mark of DCX, mainly associated to blood vessels, after 7 days of reperfusion. These results suggest a Ngb-dependent activation of neurogenesis.

**No. 16.****Modulating microglia phagocytosis after stroke**

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Ischemic stroke is one of the leading causes of death and disability in adults. Currently, there are no effective drugs to promote the functional recovery from stroke. Adequate healing of the damaged brain area depends on clearance of cell and myelin debris, but this process is slow and perturbs with neuronal regeneration. Mesencephalic astrocyte-derived neurotrophic factor (MANF) provides unprecedented neuroprotection and recovery correlating with the activity of phagocytic macrophages/microglia. Thus, enhancing phagocytosis could improve removal of cell debris. We have created a small library of lentiviral vectors (LVs) encoding different genes related to phagocytosis or recruitment of microglia/macrophages, namely Monocyte chemoattractant protein 1 (MCP1), three isoforms of Macrophage colony-stimulating factor (M-CSF), Complement Component 3 (C3), Complement Component 3a (C3a), Adhesion G protein-coupled receptor E1 (Emr1/ADGRE1/F4/80), MER receptor tyrosine kinase (MerTK) and MANF. Their effect on phagocytosis and induction of inflammation were tested in microglia (BV2) after transient transfection in vitro by phagocytosis assay and cytokine (TNF $\alpha$ , IL-6 and IL10) ELISAs. The highest effect on phagocytosis was detected with LV-MerTK, LV-MCSF32-E and LV-MCSF1-E while LV-C3a and LV-Emr1 transfections enhanced phagocytosis over 80% of the induction of the positive control. In parallel, LV-MANF and LV-MerTK were equally potent in enhancing TNF $\alpha$  and IL-6. Furthermore, we tested the delivery of LVs (LV-MCP1, LV-MCSF1-190, LV-MANF and LV-GFP) after transient distal middle cerebral artery occlusion (dMCAO) in a rat model and evaluated their effect on the number of neurons, astrocytes, and activated microglia at peri-lesion area by immunohistochemistry. In summary, this is the first study to test the use of lentiviruses as a gene delivery vehicle after ischemic stroke, and to compare the effect of different chemotactic and phagocytosis related proteins enhancing phagocytosis and changing the inflammatory profile of microglia.

**No. 17.****Multidimensional magnetic resonance imaging in the evaluation of a novel neuroglobin treatment for ischemic stroke**

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Magnetic resonance imaging (MRI) techniques are part of the clinical practice for the diagnosis and follow-up of ischemic stroke. However, the methods used in the clinic can only extract limited and unspecific information on tissue viability and treatment responses. Stroke imaging urgently requires solutions to these limitations. Here, we have evaluated stroke and a novel nanocapsulated neuroglobin (Ngb) treatment at an acute timepoint with an emerging methodology capable of sub-voxel parameter estimation, multidimensional magnetic resonance imaging (MD-MRI). MD-MRI combines traditional relaxometry and diffusion MRI into a common analysis framework to provide a full correlation between the relaxation and diffusion MRI metrics, highly specific to cellular properties. Three groups of adult male Wistar rats were included in this study: sham-operated (n = 3) and two middle cerebral artery occlusion groups, MCAO (n = 5) and MCAO+Ngb (n = 5). The brains were imaged *ex vivo* in a 11.7-T Bruker Avance-III HD MRI scanner at 24 h after reperfusion with a 10-mm probe and an in-plane resolution of 80  $\mu\text{m}$  and a slice thickness of 250  $\mu\text{m}$ . The diffusion encoding was performed with b-values between 700 and 8000  $\text{s}/\text{mm}^2$ , b-tensor encoding, with TE = 30 ms and TR = 800 ms, and a total scan time of 5 hours. The diffusion tensor distribution parameters were estimated through Monte Carlo data inversion. Region-of-interest (ROI) analysis was performed on the parameter maps and interesting trends were observable in the ROIs, for example in the cortex S1HL and S2, in several parameters. Additional statistical analysis will be performed on the results along with analyzing the per-voxel parameter distributions of MD-MRI in comparison to conventional diffusion tensor imaging (DTI). Histological validation of MD-MRI along with a longitudinal *in vivo* study on the long-term effects of the Ngb treatment will be included into this project in the future.

**No. 18.****Combined adipose tissue-derived mesenchymal stem cell therapy and rehabilitation for brain repair and functional recovery after stroke**

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**Introduction:** Emerging evidence suggest that the combination of cell-based therapy and rehabilitation results in much better brain tissue and behavioral outcomes. Thus, we studied whether the therapeutic effect of transplanted adipose tissue-derived mesenchymal stem cells (ADMSCs) could be further enhanced by rehabilitation-mimicking housing in an enriched environment (EE) in an experimental stroke model.

**Methods:** Two days after permanent middle cerebral artery occlusion (pMCAO) in rats (n=75), sham-operated (SHAM) or pMCAO animals were administered saline or ADMSCs via the tail vein, and then housed in standard cages or EE. Safety was assessed across multiple end points; and the cylinder and sticky label tests were used to evaluate sensorimotor outcomes. Brain MRI was used in the quantification of infarct size; and finally, animals were perfused for the histology of neurovascular mechanisms underlying brain repair and functional recovery after stroke.

**Results:** After IV infusion, no mortality occurred; brain MRI showed no signs of occlusions or bleeding/hemorrhage; weight gain was similar in all groups; gross neurological outcomes were normal and not different between vehicle- and cell-treated groups; and no seizures or other adverse effects were observed. Combined IV transplantation of ADMSCs and housing in EE improved the spontaneous use ( $p<0.01$ ) or the movement and coordination ( $p<0.01$ ) of the impaired forelimb on post-operative day 42 (vs pMCAO controls). Also, an additive therapeutic effect on sensorimotor recovery ( $p<0.05$ ) was observed (vs cell therapy alone or housing in EE alone); and the therapeutic effect on spontaneous forelimb use was almost maximized (vs SHAM controls). Unbiased stereology revealed an ischemia-induced increase ( $p<0.001$ ) in the length of RECA-1+ blood vessels, number of Iba1+ microglia/macrophages, or number of GFAP+ astrocytes in the perilesional cortex on post-operative day 44. ImageJ/Fiji analysis also showed an ischemia-induced increase ( $p<0.001$ ) in blood-brain barrier permeability (IgG-stained tissue) in the perilesional cortex or DCX+ neuroblast proliferation in the ipsilateral subventricular zone. These repair-related alterations were not affected by the combined therapy, though. Also, modulation of the glial scar and attenuation of the infarct size were not affected by the combined therapy.

**Conclusions:** Combined IV transplantation of ADMSCs and rehabilitation safely and additively improved long-term sensorimotor recovery in stroke rats. However, the repair and recovery mechanisms underlying the treatment effect were not identified. Efforts in the stroke recovery field should be intensified on optimizing promising combination strategies towards the maximization of therapeutic efficacy.



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Itä-Suomen yliopiston kliinisen lääketieteen yksikössä toimiva Aivotutkimusyksikkö tekee korkeatasoista **kliinistä akateemista tutkimusta** ja **kliinisiä lääke- ja laitetutkimuksia** tiiviissä yhteistyössä kansallisten ja kansainvälisten tutkimusryhmien ja lääketeollisuuden kanssa. Yksiköllä on ainutlaatuinen yli 20 vuoden kokemus potilastutkimuksista.

- ❖ **Ydinosaamisalueita** ovat hermostoa rappeuttavien sairauksien ja aivoverenkiertohäiriöiden kliiniset lääke- ja preventiotutkimukset sekä biomarkeritutkimukset.
- ❖ Yksikkö tarjoaa **tutkimus-, kehitys- ja innovaatiopalveluja** ja toimii kansainvälisesti korkealaatuisen aivoterveysten tutkimuksen mahdollistajana.
- ❖ Tiivis toiminta **yhteistyöverkoston** kanssa antaa valmiudet tutkia tautien geneettistä taustaa, riskitekijöitä ja syntymekanismeja ja tarjota lääketeollisuudelle tutkimuspalveluita klinikasta molekyylibiologiaan.



### Palvelukonsepti

- ❖ **Henkilökunta:** kaksi lääkäriä, viisi tutkimushoitajaa, kaksi psykologia sekä kehittämishankkeen projektipäällikkö ja hankeasiantuntija-controller.
- ❖ **Tutkimusten käytännön toteutus** voi sisältää mm. näytteenottoa (veri- ja aivo-selkäydinnesteenäytteet), analysointia, neuropsykologisia testejä ja lääkeannostelua.
- ❖ **Kliinisen kuvantamisen** osalta yhteistyötä tehdään KYS Kuvantamiskeskuksen kanssa.
- ❖ **Hallinnolliset toiminnot** - johtaminen, budjetointi, lakikokemus ml. sopimukset ja tutkimusetiikka.
- ❖ Yksikön yhteydessä toimii akkreditoitu **Biomarkerilaboratorio**.
- ❖ **Palveluja ja toimintaa kehitetään aktiivisesti** mm. meneillään olevan **UEF Aivotutkimusyksikkö 2.0 EAKR-kehittämishankkeen** (2023–2025) kautta. 

### Yhteistyöverkostot

- ❖ Keskeinen osa Itä-Suomen yliopiston **neurotieteiden tutkimusyhteisön (NEURO-RC)** tutkimusinfrastruktuuria sekä **Kansallisen Neurokeskuksen Kuopio Brain & Mind** -aluetoimintaa ja kansallista ja kansainvälistä verkostoa.
- ❖ Laajat kansalliset ja kansainväliset verkostot

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Kuopio Brain & Mind 

 Pohjois-Savon  
hyvinvointialue

**KUH**  
NEUROCENTER 

### Yhteystiedot

0505650598, arkisin klo 13–15 // bru@uef.fi //   
Kliinisen lääketieteen yksikkö // Lääketieteen laitos // **Aivotutkimusyksikkö** //  
Itä-Suomen yliopisto // PL 1627 // 70211 Kuopio

### Aivotutkimusyksikön johtaja

Eino Solje // 050 465 6866 // eino.solje@uef.fi

## Advanced Neuro and fMRI system distribution

Cephalon is well recognized as the specialist in Neuro and fMRI applications, as well as a supplier of high-technology medical systems and devices. Our solutions are used in a wide range of applications in the field of neuropsychological, psychological, ophthalmology and sleep diseases. Customers are hospitals, private doctors and research lab around the Nordics countries.

### Systems & solutions

Systems sold are for TCD, EEG/ERP, fMRI, EMG/EP, NCS, IOM, ERG, Neuro Imaging, Magnetic stimulation, Sleep/apnea, Heat/Cold & Pain sensation and many more applications.

### Locations

Cephalon is represented in Finland, Denmark, Norway and Sweden. Main office is located in Aalborg, Denmark

Here we are presenting Dolphin TCD by Viasonix.

# Dolphin Transcranial Doppler

Taking TCD Technology One Step Further

## DOLPHINMAX

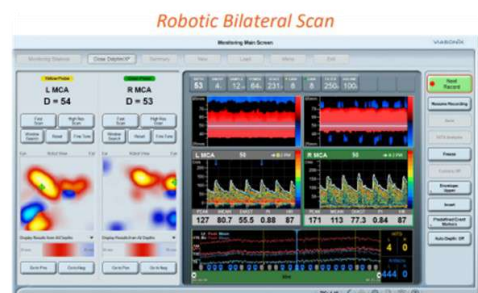
Battery Operated TCD System

## DOLPHIN4D

Standalone TCD System

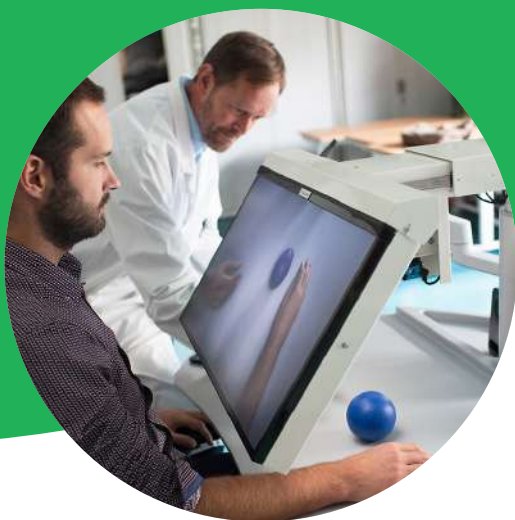
## DOLPHINIQ

TCD Module




Effective rehabilitation belongs to everyone

# **REHABILITATION TECHNOLOGY SOLUTIONS**



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# Multiprofessionall rehabilitation, body and mind wellbeing

**Kruunupuisto has been working among  
rehabilitation services over 50 years.**

Our rehabilitation centre has become a versatile place for people who has some difficulties in their daily life and need for rehabilitation, especially with neurological deceases. We are situated in unique environment at lake Saimaa and Punkaharju ridge area – this beautiful landscape and nature also supports achieving the goals in rehabilitation.

You can find information about our rehabilitation services, especially for neurological patients, in our website [www.kruunupuisto.fi](http://www.kruunupuisto.fi)

Please contact us, if you have any questions:

[myyntipalvelu@kruunupuisto.fi](mailto:myyntipalvelu@kruunupuisto.fi)  
+358 44 763 9130



A woman is seen from behind, wearing a black safety harness that is suspended from a ceiling-mounted system. She is standing on a treadmill. A male therapist in a dark polo shirt is looking at her. The background shows a bright, modern clinical or laboratory setting with large windows and white walls. In the top right corner, there is an orange and yellow curved graphic element.

LIVE

” Our mission is to help customers to restore their functional abilities and return to their daily activities.”



## Live Foundation – rehabilitation services

Live Neuron at Kuopio Finland provides a rehabilitation program that is especially designed for a customer with neurological disorders such as stroke and brain injury.

We strongly encourage our customers and their families to actively participate in the rehabilitation process.

The individual program is supervised by a multidisciplinary team combined with a state of art technology enabling the customers to reach their full recovery potential.

We offer our expertise to provide rehabilitation for customers at their early stages of rehabilitation as well as further on to support the long running path to their normal lives.



### Live Neuron

Letkukaari 5B, 70820 Kuopio | Tel. 050 430 2040 | [neuron@inlive.fi](mailto:neuron@inlive.fi) | [www.livesaatio.fi](http://www.livesaatio.fi)

Jot Dx™ ICM

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YOUR CONTROL

[ALL] EPISODES

THREE KEY EPISODES OR ALL EPISODES

[3 KEY] EPISODES



## Reduce your data burden and increase your control with Jot Dx™ ICM.\*

Introducing the ICM that reduces time-consuming data burden: a key episode feature delivers flexibility to control the data flow.

Jot Dx™ ICM gives you the precise, actionable EGM insights you need to accurately diagnose difficult-to-detect arrhythmias—including atrial fibrillation.

\*Key episodes is a feature of Merlin.net™ Patient Care Network.



[ALL] EPISODES



[3 KEY] EPISODES



Jot Dx™ ICM: Actual size

### Reference

1. EGM Burden Reduction in Jot Dx™ ICM, Technical Development Report System DOC 90805939 Rev A.

### Abbott

The Corporate Village, Da Vincilaan 11 Box F1, 1935 Zaventem, Belgium, Tel: +32 2 774 68 11  
cardiovascular.abbott

**Brief Summary:** Prior to using these devices, please review the Instructions for Use for a complete listing of indications, contraindications, warnings, precautions, potential adverse events and directions for use.

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\*Pharmarket MAT 07-2023







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- Does not restrict patient's normal life



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**AXS Infinity LS Plus**  
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**AXS Vecta 74**  
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**Trevu Trak 21**  
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ratiopharm

teva

# Beat2Phone helps solve the mystery of cerebral events

*Determining the cause of cerebral infarctions and transient ischaemic attacks has traditionally involved tracking down several tiny clues. Lohja Hospital inpatient care has been piloting VitalSignum's Beat2Phone ECG sensor which is turning out to be a time and resource-saving tool for this investigative work.*



Identifying the cause of a cerebral event is a complex and taxing process. Looking pensive, Markus Wiksten, the Chief Physician of Neurology at Lohja Hospital, recalls how tending to patients with cerebral infarctions and transient ischaemic attacks traditionally goes: "First we try to determine if there is stenosis in the arteries carrying blood to the brain. ECG is typically up next for investigating potential underlying causes. Patients are also interviewed to find out if they have experienced palpitations or other sensations of arrhythmia, and then we seek a cardiologist's evaluation. And as patients are discharged, they may be assigned Holter monitoring based on any findings or indicative symptoms."

"Holter requires a separate appointment for attaching the device, meaning a visit to the hospital. Furthermore, the device has to be returned and a nurse needs to arrange for patient debriefing. Next, data is offloaded to the system and the results are taken to a cardiologist for a statement. Due to multiple steps involved and the cardiologists being as busy as they are, getting results may take up to two months."

## Help for finding the smoking gun

When VitalSignum's Beat2Phone ECG sensor comes up, Wiksten's face lightens up: "We can pare down the time required from months to just a couple of days. Results might already be available when the patient is discharged, or within a couple of weeks at the latest." According to Wiksten, another advantage with this approach is that the ECG recording can start while the patient is still in inpatient care. Hidden atrial fibrillation has a tendency to return to the crime scene early on, so this improves the chance of catching it. "It helps us find the smoking gun, so to speak."

VitalSignum's Beat2Phone has been piloted at the Lohja Hospital since autumn 2021. Based on the first 30 patients, Wiksten considers the device a success because the work required to identify the cause of a cerebral event has decreased significantly in inpatient care. It has increased neurologists' workload a bit, however, as they are now required to comment on ECG's.

## Easy to use, with easy-to-read results

The patient segment is ideal for the purposes of the pilot. They need acute inpatient care for a cerebral infarction or TIA, making them definite high-risk. "We can hook them up right away by a decision from the senior ward physician and start monitoring the heartbeat and determining the cause of the cerebral event. And unlike in Holter monitoring, we don't need to send the device home with the patient," Wiksten says. The ease of use and quick results work to the patients' advantage too, and even the nursing staff seems to have given their silent approval: "We've had practically no complaints about this device."

According to Wiksten, the evidence is easy to read: "A visit to the patient is not required. I'll simply log in to the system and check events in the data highlighted by the algorithm used by VitalSignum."

## Visions for future

In the HUS organisation, operators such as the Lohja Hospital are satellites to Meilahti. And even though VitalSignum's Beat2Phone ECG sensor is used in Meilahti as well, they send the device home with their patients. However, Wiksten thinks that the Lohja method works well: "We get the immediate benefit out of it in inpatient care and the need for Holter is reduced".

And as its use is further developed and its reliability improved, it could be strapped on a patient already at the emergency clinic: "Overnight data would be ready in the morning, so we could detect any atrial fibrillation right away."



[www.vitalsignum.com](http://www.vitalsignum.com)  
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## PO MEDICA - YOU WILL FIND US IN THE MIDDLE OF NOWHERE

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We have designed one of the most modern education centers for surgical training in Europe, and we offer ultra-modern medical equipment in radiology, orthopedics, neurosurgery, ear, nose and throat surgery and more.

## NovaGuide™ 2 – Robotic TCD Ultrasound with cutting edge AI and advanced robotics

### NovaGuide™ 2 Intelligent Ultrasound

With cutting-edge AI and advanced robotics, the revolutionary NovaGuide 2 Intelligent Ultrasound uniquely captures blood flow data in real time to identify brain illnesses and diseases that present as changes in cerebral blood flow. NovaGuide 2 provides the clinical team with critical information to guide patient diagnosis and treatment.

The Only Fully Autonomous,  
AI-Driven Robotic Transcranial  
Doppler Ultrasound System



DEMONSTRATION IN OUR BOOTH

TCD is Recognized as the Standard of Care  
at Comprehensive Stroke Centers<sup>1</sup>

1. Practice Standards for Transcranial Doppler (TCD) Ultrasound, Part II: Clinical Indications and Expected Outcomes. Andrei V. Alexandrov MD. | Neuroimaging 2012;22:215-224.

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## **ABDULHAMEED BAKREEN (ED.)**

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The XXII Nordic Stroke Society Congress 2023 is jointly organized by the University of Eastern Finland, Institute of Clinical Medicine, Neurology; Kuopio University Hospital; and the Nordic Stroke Society. The theme of the congress is the latest development in stroke care, research, and translational science presented by stroke professionals and researchers from Nordic and Baltic countries. The scientific program includes workshops, lectures, talks, and posters on recent clinical and translational/experimental advances in stroke prevention, acute management, rehabilitation, and recovery. Non-scientific perspectives from stroke patients is also included. This book compiles the program and abstracts of the XXII Nordic Stroke Society Congress 2023 held in Kuopio, Finland, August 21-23, 2023.



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