Measuring the Impact of Delayed Cerebral Ischemia on Neuropsychological Outcome After Aneurysmal Subarachnoid Hemorrhage—Protocol of a Swiss Nationwide Observational Study (MoCA–DCI Study)

Stienen, Martin N; Fung, Christian; Bijlenga, Philippe Alexandre Pierre; Zumofen, Daniel W; Maduri, Rodolfo; Robert, Thomas; Seule, Martin A; Marbacher, Serge; Geisseler, Olivia; Brugger, Peter; Gutbrod, Klemens; Chicherio, Christian; Monsch, Andreas U; Beaud, Valérie [**and 6 more**]

Measuring the impact of delayed cerebral ischemia on neuropsychological outcome after aneurysmal subarachnoid hemorrhage – protocol of a Swiss nationwide observational study (MoCA – DCI study)

Martin N. Stienen[1], MD; Christian Fung[2], MD; Philippe Bijlenga[3], MD/PhD; Daniel Zumofen[4], MD; Rodolfo Maduri[5], MD; Thomas Robert[6], MD; Martin A. Seule[7], MD; Serge Marbacher[8], MD/PhD; Olivia Geisseler[9], PhD; Peter Brugger[9], PhD; Klemens Gutbrod[10], PhD; Christian Chicherio[11], PhD; Andreas Monsch[12], PhD; Valérie Beaud[13], MSc; Stefania Rossi[14], MSc; Severin Früh[15], MSc; Nicole Schmid[16], PhD; Nicolas R. Smoll[17], MBBS; Emanuela Keller[1], MD; Luca Regli[1], MD **on behalf of the MoCA – DCI study group***

[1]Department of Neurosurgery, University Hospital Zurich, Zurich, Switzerland
[2]Department of Neurosurgery, University Hospital Berne, Berne, Switzerland
[3]Department of Neurosurgery, University Hospital Geneva, Geneva, Switzerland
[4]Department of Neurosurgery, University Hospital Basel, Basel, Switzerland
[5]Department of Neurosurgery, University Hospital Lausanne, Lausanne, Switzerland
[6]Department of Neurosurgery, Ente Ospedaliero Cantonale, Lugano, Switzerland
[7]Department of Neurosurgery, Kantonsspital St.Gallen, St.Gallen, Switzerland
[8]Department of Neurosurgery, Kantonsspital Aarau, Aarau, Switzerland
[9]Neuropsychology Unit, Department of Neurology, University Hospital Zurich, Zurich, Switzerland
[10]Neuropsychology Unit, Department of Neurology, University Hospital Berne, Berne, Switzerland
[11]Neuropsychology Unit, Department of Neurology, University Hospital Geneva, Geneva, Switzerland
[12]Neuropsychology Unit, Department of Neurology, Memory Clinic Basel, Basel, Switzerland
[13]Neuropsychology Unit, Department of Neurology, University Hospital Lausanne, Lausanne, Switzerland
[14]Neuropsychology Unit, Department of Neurology, Ente Ospedaliero Cantonale, Lugano, Switzerland
[15]Neuropsychology Unit, Department of Neurology, Kantonsspital St.Gallen, St.Gallen, Switzerland
[16]Neuropsychology Unit, Department of Neurology, Kantonsspital Aarau, Aarau, Switzerland

[17]School of Medicine and Public Health, University of Newcastle, Callaghan NSW 2308, Australia

***Contributors are listed in the appendix**

Correspondence to:

Martin N. Stienen, MD

Department of Neurosurgery

University Hospital Zurich

Clinical Neuroscience Center

University of Zurich

Frauenklinikstrasse 10

8091 Zurich, Switzerland

Tel: +41 (0)44-255-1111

Email: mnstienen@gmail.com

Previous presentations:

The study methodology was presented as an invited lecture at the 2018 BRAIN conference, organized by the Chinese University of Hongkong.

Disclosure of Funding:

This research is financially supported by Idorsia Pharmaceuticals Ltd. The funding source is not involved and does not influence the data collection, measurements, interpretation, or drafting of the manuscript.

Competing interests statement:

All authors declare that they have nothing to disclose and no conflicts of interest.

Appendix: Contributors of the "MoCA - DCI study group" (departments and persons listed in alphabetical order):

Department of Neurosurgery, University Hospital Zurich, Zurich, Switzerland:

- Oliver Bozinov, MD
- Jan-Karl Burkhardt, MD
- Giuseppe Esposito, MD/PhD

- Menno R. Germans, MD/PhD
- Emanuela Keller, MD
- Niklaus Krayenbühl, MD
- Nicolai Maldaner, MD
- Marian C. Neidert, MD
- Luca Regli, MD
- Martina Sebök, MD
- Carlo Serra, MD
- Martin N. Stienen, MD
- Julia Velz, MD

Department of Neurosurgery, Kantonsspital Aarau, Aarau, Switzerland

- Serge Marbacher, MD/PhD
- Javier Fandino, MD
- Donato D'Alonzo, MD

Neuro-Research Office, Kantonsspital Aarau, Aarau, Switzerland

- Christine Galiagousis
- Carline Perren
- Andrea Stoller

Department of Neurology, Kantonsspital Aarau, Aarau, Switzerland

- Krassen Nedeltchev, MD

Department of Neurosurgery, University Hospital Basel, Basel, Switzerland

- Raphael Guzman, MD
- Luigi Mariani, MD
- Daniel Zumofen, MD
- Marianne Schulz
- Heike Neddersen
- Kristine Blackham, MD

Department of Neurosurgery, University Hospital Berne, Berne, Switzerland

- Jürgen Beck, MD
- Christian Fung, MD
- Johannes Goldberg, MD
- Andreas Raabe, MD
- Daniel Schöni, MD

Department of Neurosurgery, University Hospital Geneva, Geneva, Switzerland

- Andrea Bartoli, MD
- Nalla Silva Baticam, MD
- Philippe Bijlenga, MD/PhD
- Paul Constanthin, MD
- Marco Corniola, MD
- Cristina Goga, MD
- Ramona Guatta, MD
- Gianpaolo Jannelli, MD
- Adrien May, MD
- Alessandro Moiraghi, MD
- Granit Molliqaj, MD
- Karl Schaller, MD
- Lima Sprenger, MD
- Thomas Wälchli, MD

Department of Neurosurgery, University Hospital Lausanne, Lausanne, Switzerland

- Roy Thomas Daniel, MD
- Rodolfo Maduri, MD
- Alda Rocca, MD

Department of Neurosurgery, Ente Ospedaliero Cantonale, Lugano, Switzerland

- Alessio Chiappini, MD
- Michael Reinert, MD
- Thomas Robert, MD

Department of Neurosurgery, Kantonsspital St.Gallen, St.Gallen, Switzerland

- Martin Hlavica, MD
- Timothy Killeen, MD
- Martin A. Seule, MD
- Astrid Weyerbrock, MD

Neuropsychology Unit, Department of Neurology, Kantonsspital Aarau, Aarau, Switzerland

- Nicole Schmid, PhD
- Andrea Kälin, PhD

Neuropsychology Unit, Department of Neurology, Memory Clinic Basel, Basel, Switzerland

- Andreas Monsch, PhD

- Anja Larissa Waldmeier

Neuropsychology Unit, Department of Neurology, University Hospital Berne, Berne, Switzerland

- Djana Albert, PhD
- Ulrike Baas, PhD
- Dario Cazzoli, PhD
- Silvia Chavas, PhD
- Barbara Gutbrod, PhD
- Klemens Gutbrod, PhD
- Dörthe Heinemann, PhD
- Helene Hofer, PhD

Neuropsychology Unit, Department of Neurology, University Hospital Geneva, Geneva, Switzerland

- Christian Chicherio, PhD

Neuropsychology Unit, Department of Neurology, University Hospital Lausanne, Lausanne, Switzerland

- Valérie Beaud, MSc
- Léa Fiorillo, MSc
- Laurance Wahl, MSc

Neuropsychology Unit, Department of Neurology, Ente Ospedaliero Cantonale, Lugano, Switzerland

- Stefania Rossi, MSc
- Fabiana Zanchi, MSc

Neuropsychology Unit, Department of Neurology, Kantonsspital St.Gallen, St.Gallen, Switzerland

- Severin Früh, MSc
- Sylvia Zimmerer, PhD
- Marc Schwind, PhD

Neuropsychology Unit, Department of Neurology, University Hospital Zurich, Zurich, Switzerland

- Peter Brugger, PhD
- Noemi Dannecker
- Olivia Geisseler, PhD
- Yannick Rothacher

- Ladina Schlosser

School of Medicine and Public Health, University of Newcastle, Callaghan NSW 2308, Australia

- Nicolas R. Smoll, MBBS

Neuropsychology Unit, Department of Neurology, Kantonsspital Chur, Chur, Switzerland

- Antoinette E. Zweifel-Zehnder, PhD

Department of Neurosurgery, University Hospital Göttingen, Göttingen, Germany

- Bawarjan Schatlo, MD

Author contributions

Those persons listed as authors on the manuscript have made substantial contributions to the conception or design of the work, are currently involved in acquiring, analysing, or interpreting the data for the work. They all have been active in drafting or revising the study protocol for important intellectual content, which is basis of the current article. All authors have approved the final version to be published. They agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

In detail: MNS, CF, PB, DZ, RM, TR, MAS, SM, OG, PB, KG, CC, AM, VB, SR, SF, NS, NRS, EK and LR designed the study and are local principle investigators or other local key persons. MNS reviewed the literature, acquired the data and drafted the manuscript. CF, PB, DZ, RM, TR, MAS, SM, OG, PB, KG, CC, AM, VB, SR, SF, NS, NRS, EK and LR contributed to drafting of the manuscript. All authors read and approved the final manuscript.

Abstract

Background: The exact relationship between delayed cerebral ischemia (DCI) following aneurysmal subarachnoid hemorrhage (aSAH) and neuropsychological impairment remains unknown, as previous studies lacked a baseline examination after aneurysm occlusion but before the DCI-period. Neuropsychological evaluation of acutely ill patients is often applied in a busy intensive care unit (ICU), where distraction represents a bias to the obtained results.

Objective: To evaluate the relationship between DCI and neuropsychological outcome after aSAH by comparing the Montreal Cognitive Assessment (MoCA) results in aSAH patients with and without DCI at 3 months with a baseline examination before the DCI-period (part 1). To determine the reliability of the MoCA, when applied in an ICU setting (part 2).

Methods: Prospective, multicenter, observational study performed at all Swiss neurovascular centers. For part 1, n=240 consecutively recruited aSAH patients and for part 2, n=50 patients with acute brain injury are recruited.

Expected Outcomes: Part 1: Effect size of the relationship between DCI and neuropsychological impairment (MoCA). Part 2: Reliability measures for the MoCA.

Discussion: The institutional review boards approved this study on July 4th 2017 under case number BASEC 2017-00103. After completion, the results will be offered to an international scientific journal for peer-reviewed publication. This study determines the exact impact of DCI on the neuropsychological outcome after aSAH, unbiased by confounding factors such as early brain injury or patient-specific characteristics. The study provides unique insights in the neuropsychological state of patients in the early period after aSAH.

Trial registration: ClinicalTrials.gov identifier: NCT03032471.

Short title

Protocol of the MoCA – DCI study

Key words

Delayed Cerebral Ischemia; Cognitive Disorders; Montreal Cognitive Assessment; Outcome; Reliability; Stroke; Subarachnoid Hemorrhage

General Information

Protocol title: Measuring the impact of delayed cerebral ischemia on neuropsychological outcome after aneurysmal subarachnoid hemorrhage – protocol of a Swiss nationwide observational study (MoCA – DCI study)

Protocol identifying number: BASEC 2017-00103

Date: July 4th, 2017

Sponsor: Luca Regli, MD; Department of Neurosurgery; University Hospital Zurich; Clinical Neuroscience Center; University of Zurich; Frauenklinikstrasse 10; 8091 Zurich, Switzerland; Tel: +41 (0)44-255-1111

Coordinating study leader: Martin Stienen, MD; Department of Neurosurgery; University Hospital Zurich; Clinical Neuroscience Center; University of Zurich; Frauenklinikstrasse 10; 8091 Zurich, Switzerland; Tel: +41 (0)44-255-1111

Funding: Idorsia Pharmaceuticals Ltd.; Hegenheimermattweg 91; 4123 Allschwil; Switzerland; Tel: +41 (0)58-844-0000

Principle investigator(s) responsible for conducting the research:

Site 1: Aarau

PD Dr. med. Serge Marbacher

Neurochirurgische Klinik

Kantonsspital Aarau

Aarau, Switzerland

Email: serge.marbacher@ksa.ch

Site 2: Basel

Dr. med. Daniel Zumofen

Klinik und Poliklinik für Neurochirurgie

Universitätsspital Basel

Basel, Switzerland

Email: daniel.zumofen@usb.ch

Site 3: Berne
Dr. med. Christian Fung
Universitätsklinik für Neurochirurgie
Inselspital
Bern, Switzerland
Email: christian.fung@insel.ch

Site 4: Geneva
PD Dr. med. Philippe Bijlenga
Département des Neurosciences cliniques
Service de Neurochirurgie
Hôpitaux Universitaires de Genève
Genève, Switzerland
Email: philippe.bijlenga@hcuge.ch

Site 5: Lausanne
Dr. med. Rodolfo Maduri
Service de Neurochirurgie
Centre Hospitalier Universitaire Vaudois (CHUV)
Lausanne, Switzerland
Email: Rodolfo.Maduri@chuv.ch

Site 6: Lugano
Dr. med. Thomas Robert
Servizio di Neurochirurgia EOC
Ospedale Regionale di Lugano - Civico e Italiano
Lugano, Switzerland
Email: thomas.robert@eoc.ch

Site 7: St.Gallen
Dr. med. Martin Seule
Klinik für Neurochirurgie
Kantonsspital St. Gallen

St. Gallen, Switzerland
Email: martin.seule@kssg.ch

Site 8: Zurich
Dr. med. Martin N. Stienen
Universitätsklinik für Neurochirurgie
Universitätsspital Zürich
Zürich, Switzerland
Email: mnstienen@gmail.com

Rationale and Background Information

Aneurysmal subarachnoid hemorrhage (aSAH) is associated with high mortality and morbidity.[1] Early brain injury is typically attributed to the severity of the initial or re-bleeding, acute hydrocephalus, or results from aneurysm occlusion.[2] The subacute phase after aSAH is characterized by delayed cerebral ischemia (DCI),[3 4, 5 1] with higher incidence in patients with early brain injury.[6-9]

DCI is among the most important predictors of neurological morbidity and the dominating risk factor for mortality in patients surviving initial aneurysm repair.[2, 10] However, survival rates are improved in modern neurosurgical patient care and functional aspects of the clinical outcome become increasingly important.[11, 12] DCI has recently been identified to be an important predictor of neuropsychological deficits (NPD),[13, 14] but the exact role of DCI needs to be confirmed by further investigations. Previous studies were always subject to methodological weaknesses, as no study ever used a baseline evaluation before DCI onset, therefore subject to confounding by early brain injury.

The Montreal Cognitive Assessment (MoCA) is a short but comprehensive instrument,[15, 16] incorporated into the Swiss national standard on neuropsychological outcome assessment[11, 17] and "highly recommended" by the National Institute of Health (NIH)/National Institute of Neurological Disorders and Stroke (NINDS) Common Data Elements (CDE) group.[18] Despite its use in aSAH patients, its validity and reliability has only been demonstrated for Parkinson's disease or dementia.[19, 20] Besides, the MoCA is often applied in the busy intensive care unit (ICU), while it remains largely unknown whether the distraction in such an environment influences the results.

Study Goals and Objectives

This study aims to determine the exact impact of DCI on the neuropsychological outcome, as measured by the in-subject difference of the MoCA before and after the DCI period (=Δ-MoCA) in patients with or without DCI (Figure 1).

1. $H_0$1: There is no difference in Δ-MoCA between patients with and without DCI.

In addition, the study determines the MoCA's test-retest-, as well as its reliability in an ICU setting (Figure 2).

2. $H_0$2: The MoCA assessment on the ICU does not result in worse results, compared to the office.
3. $H_0$3: The test-retest reliability of the MoCA is high.

Study Design

Part 1 is set up as a prospective nationwide multicenter observational cohort study on aSAH patients, conducted at all Swiss neurosurgical departments that treat aSAH patients (Table 1). Part 2 of the study is performed at the main site only, including patients with acute brain injury that are clinically stable and transferable without risk, as proxy for aSAH patients (Table 2). The rational for this is that aSAH patients cannot be randomly assigned to assessment on the (busy) ICU or the (quiet) office, as bed rest, careful control of hemodynamics, oxygenation and temperature is recommended up to day 14 to minimize the risk for DCI.

Methodology

The study will be reported according to the STROBE guidelines.[21]

Eligibility criteria

For part 1 of the study, adult aSAH patients of at least 18 years of age who fulfill all of the following inclusion criteria:

- Consent of the patient or consent of patient's next of kin (plus consent of an independent physician if patient is unable to consent)
- Time of aSAH known (IMPORTANT: at least approximated. Time of aSAH refers to the bleed that led to hospital admission; warning leaks/sentinel headache are not considered aSAH in this context)[22]
- Complete aneurysm occlusion therapy within 48h after aSAH
- GCS $\geq$ 13 points at time point 48h – 72h after aSAH
- Fluent language skills in either English, German, French, or Italian

For part 2 of the study, adult patients who suffer from acute brain injury that requires an in-patient treatment, e.g. for (surgical) treatment of a brain tumor, intracranial hemorrhage, hydrocephalus, stroke, or traumatic brain injury, with stable neurological and general health status and fulfill all of the following inclusion criteria:

- Consent of the patient
- GCS $\geq$ 13 points
- Fluent language skills in German

The exclusion criteria for study participation are listed in Supplementary Digital Content 1 (part 1) and 2 (part 2).

Interventions

None. Patients are treated according to local protocols that comply with recent recommendations.[10, 11, 23, 24]

Study groups

For part 1 of the study, assignment to one of two study groups (see below) is done at hospital discharge. Patients that experience DCI, defined as

(1) Cerebral infarction identified on imaging or proven at autopsy, after exclusion of procedure-related infarctions; and

(2) Clinical deterioration caused by DCI, after exclusion of other potential causes of clinical deterioration

will be assigned to the DCI group. All other patients will be assigned to the non-DCI group (Figure 1). Definitions of clinical deterioration and cerebral infarction attributable to DCI follow the current gold standards.[4, 5]

Primary Outcome and Follow-Up

Proportion of patients with or without DCI that show worsening on the MoCA 3 months after the ictus, as compared to before the DCI phase by at least two points (=minimum clinically important difference (MCID)).[20, 25]

Secondary Outcomes

Neuropsychology/MoCA

- Proportion of patients with or without DCI that show worsening on the MoCA 14-28 days after the ictus, as compared to before the DCI phase by at least two points.[20, 25]
- Absolute difference in the MoCA score between 48-72h after aSAH and at 3 months after aSAH in patients that develop and those that do not develop DCI
- Absolute difference in the MoCA score between 48-72h after aSAH and at 14-28 days after aSAH in patients that develop and those that do not develop DCI
- Absolute results of the MoCA at 48-72h, 14-28 days and 3 months in patients that develop and those that do not develop DCI
- Reliability of the MoCA when tested in the ICU unit, as compared to testing in the office setting (Part 2)
- Test-retest reliability of the MoCA (Part 2)
- Correlation of the MoCA at 48-72h with the Alberta Stroke Program Early CT Score (ASPECTS) [26] for ischemic lesions on the CT-scan/MRI at 24-72h after aSAH

- Correlation of the MoCA at 14-28 days with the ASPECTS [26] at 12-21 days
- Correlation of the MoCA at 3 months with the ASPECTS [26] at 6 weeks - 3 months

Death/Disability

- Mortality at 3 months in patients that develop and those that do not develop DCI
- Distribution of modified Rankin scale (mRS) at 3 months in patients that develop and those that do not develop DCI
- Dependency (=mRS 4&5) at 3 months in patients that develop and those that do not develop DCI
- Home time at 3 months in patients that develop and those that do not develop DCI [27]

Health-related quality of life (HRQoL)

- HRQoL (Euro-Qol (EQ5D)) at 3 months in patients that develop and those that do not develop DCI

For tertiary and other outcomes of interest, see Supplementary Digital Content 3.

Discussion

The exact impact of DCI on the neuropsychological outcome remains unknown today. Previous studies have reported strong relationships,[13, 14, 28] but those were likely biased by early brain injury. Even with statistical adjustment can the true association between DCI and neuropsychological outcome only be roughly estimated. It is possible to obtain more robust estimates by use of a baseline examination before onset of the DCI phase, however. The time window 48 – 72 hours after the hemorrhage, when the aneurysm is secured, is sometimes referred to as "honeymoon period", as patients can often be extubated and neuropsychologically assessed. DCI rarely occurs before day 3 and after day 14, but manifests to the maximum between days 5 – 14.[10] Assessing the neuropsychological status is thus possible both before and after the studied condition (DCI), enabling determination of its accurate relationship in a causal fashion. This convenient situation is similar to neuropsychological testing before and after elective brain surgery for e.g. the removal of a neoplastic lesion, whereas e.g. in traumatic brain injury research usually no neuropsychological testing before the injury is possible.

The chosen study methodology also has weaknesses. We will not be able to include many poor-grade aSAH patients into the study, as they can or should not awake from sedation for the initial assessment before the DCI period. Of note, the study protocol does not exclude patients with high WFNS grades *per se.* Patients graded poor at admission due to a reversible

condition (e.g. hydrocephalus or space-occupying hematoma) can be included, if meeting the inclusion criteria at 48-72h. In addition, other factors that may influence the neuropsychological outcome and occur in parallel to DCI (e.g., chronic hydrocephalus, infectious or other medical complications) can potentially bias the results. Those factors are prospectively collected and will be statistically adjusted for. The fact that for part 2 we chose patients with acute brain injury as substitute raises question, as to whether the findings are applicable to aSAH patients. We hope that this heterogeneous group of patients, many of them having experienced stroke, hydrocephalus and recent brain surgery, will resemble well the typical aSAH patient population. In any case, the final results will have to be interpreted within these limitations.

Trial Status

The study has started recruiting patients on July 20th, 2017 and is currently conducted in seven of the eight specified centers (all, except for Kantonsspital Aarau).

Safety Considerations

Due to the observational design of the study there are no safety concerns. Adverse events, such as clinical deterioration at time of neuropsychological assessment, are recorded and reported, however.

Follow-up

Participating patients are followed for three months after aSAH.

Data Managements and Statistical Analysis

The data is hosted by the Clinical Trials Center (CTC), University of Zurich. Electronic case report forms are implemented. All data are stored on a server in a dedicated database. A role concept with personal passwords (site investigator, statistician, monitor, administrator etc.) regulates permission.

Supplementary Digital Content 4 outlines the variable definitions, consistent with the NIH/NINDS CDE project for "Unruptured Cerebral Aneurysms and Subarachnoid Hemorrhage".[18]

Handling of missing data

All efforts first concentrate on avoiding and minimizing the chance of missing data, including regular data reviews. Contingency plans foresee home visits and collaboration with the rehabilitation clinics. Patients who die or cannot be evaluated (as in poor clinical condition)

and in whom for this reason no MoCA at follow-up can be obtained will be considered to have cognitive impairment (MoCA=0 points). Sensitivity analyses will be performed.

If missing data is still present:

1. First, mechanisms of missing data are assessed. If the data are deemed missing at random, and there is <10-15% of patients with time point missing data, case deletion will be used (and additional patients will be recruited).
2. Second, if the missing data mechanism is not at random,[29] multiple imputation will be performed.

For the second part of the study, only patients with complete datasets will be analyzed.

Determination of sample size

There is no data available on the change in MoCA in the early period after aSAH. When estimating that 70% of patients with DCI and 40% of patients without DCI will worsen by two points on the MoCA,[20, 25] n=42 patients per group are required to detect a statistically significant effect with a power of 80% and alpha set at 0.05. In order to allow for statistical adjustment, 60 patients with DCI should be included. Given that 25% of the total aSAH population suffers from DCI,[1, 4, 5] the study will need to include n=240 patients.

There is no data available in the literature allowing estimating the required sample size for part 2. Including n=50 subjects in total (thus, 25 randomized in each study arm) is considered sufficient.

Methods used to minimize bias

Part 2 uses a computerized randomization process to distribute patients to initial testing in the ICU or office, respectively. The same randomization process allocates patients to either the original version or official parallel version 1 of the MoCA.

The neuropsychological assessment at 14-28 days and 3 months will be performed by a professional neuropsychologist, blinded for the study group allocation of the patient (DCI-group or non-DCI group).

The primary outcome might be influenced by the following factors that are therefore prospectively recorded and, if unequally distributed, statistically adjusted for: patient age & sex, WFNS score, hydrocephalus, aneurysm occlusion therapy, prophylactic nimodipine [7], induced hypertension (rescue therapy I), chemical vessel dilatation (rescue therapy II), balloon dilatation (rescue therapy III), infectious, pulmonary or cardiac complications.

Primary analysis

A decrease of the MoCA by at least 2 points at 3 months post-aSAH, as compared to the baseline examination, will be calculated for patients with and those without DCI.[20, 25] Logistic regression will be used to calculate the odds ratio (OR) and 95% confidence intervals (CIs) to estimate the effect size of DCI on the neuropsychological outcome. Multivariable analysis will adjust for the mentioned confounding factors.

Secondary analyses – part 1

For secondary analyses, MoCA results will be expressed as raw values, but also standardized for age, sex and education based on Swiss normative values.

The significance of the absolute group difference (Δ-MoCA) between patients with and without DCI can be calculated using rank-sum tests. The proportion of patients with and without DCI that show cognitive impairment (MoCA < 26)[13] can be analyzed using logistic regression.

The MCID of the MoCA will be determined with mRS, GCS and NIHSS scores as anchors by the average change, minimum detectable change, and the change difference approach.[30]

Secondary analyses – part 2

For reliability measures, official parallel MoCA versions are used in order to prevent from learning effects and to reduce false reliability. We will estimate three key effects: sequence (S), period (P), and location (L) of testing

To estimate the effect size of *S*, the mean difference of sequence 1 (ICU first): $(A = A_1 - A_2)$ is compared to the mean difference of sequence 2 (Office first): $(B = B_1 - B_2)$ and tested using an unpaired t-test. For the null hypothesis to be true, $\overline{A} = \overline{B}$.

To estimate the effect size of *P*, the average of the differences for all patients in both sequences are calculated:

$$P = (A_1 - A_2 + B_1 - B_2)/2$$

For the null hypothesis to be true, $\overline{P} = 0$.

To estimate the effect size of *L*, the difference between Office MoCA (O) and ICU MoCA (I) is measured:

$$L = O_1 - I_2 + O_2 - I_1)/2$$

For the null hypothesis to be true, $\overline{L} = 0$.

Because each patient serves as his/her own control, demographic/patient level variables are treated as fixed effects.

The clinical relevance of Δ-MoCA will be appraised referring to the reported MCID.[20, 25]

The intraclass correlation coefficient (ICC) of repeated MoCA will be interpreted according to Cichetti with ICC <0.40 (poor), 0.40-0.59 (fair), 0.60-0.74 (good) and 0.75-1.00 (excellent).[31]

Statistical significance is defined as p-value < 0.05.

Quality Assurance

All source data is accessible for monitoring, audits and inspections. Authorities have the right to perform inspections, and the sponsoring institution has the right to perform on-site auditing. Monitoring for each site will be performed at study initiation and before the results are to be analyzed as follows: completeness of documents, adherence to the study protocol and data quality entered into the eCRFs for the first patient, as well at least every fifth included patient. Progress of patient inclusion and data completeness is checked continuously, at least once every two weeks.

Expected Outcomes of the Study

Part 1: Effect size of the relationship between DCI and neuropsychological impairment (MoCA). If DCI was to be confirmed as major driver of neuropsychological deficits, future research should focus even more on the effective prevention and treatment of this potentially modifiable condition. On the contrary, if the association between DCI and neuropsychological impairment was less strong than expected, funding could better be spent on e.g. the prevention of early re-bleeding or lass invasive aneurysm occlusion techniques, among others.[2]

Part 2: Reliability measures for the MoCA. Early neuropsychological evaluation finds entry into the management of a broad variety of acute central nervous system disorders nowadays,[32, 33] and studying a heterogeneous patient sample allows for generalizing the results to the wider neurosurgical population.

Duration of the project

Recruitment is expected to be complete by the end of July 2019.

Project management

At each site, the principle investigator (PI) is responsible for patient inclusion, quality of data collection and adhesion to the protocol. The PI is supported by the sponsor and the coordinating study leader.

Ethics

The study protocol has been approved by all IRBs on July 4th, 2017 (BASEC 2017-00103) and registered with the ClinicalTrials.gov identifier: NCT03032471. All patients and/or next-of-kin will give written informed consent.

Figure legends

Figure 1.

Illustration of part 1 of the study. After initial treatment of the ruptured aneurysm, eligible patients undergo the first assessment with the Montreal Cognitive Assessment (MoCA) before the delayed cerebral ischemia (DCI) phase. Then, some patients will experience DCI over the next days, whereas others will not. After termination of the DCI phase, all patients undergo the second assessment and a third assessment at 3 months after the hemorrhage (follow-up). The difference between the MoCA before and after the DCI period or at follow-up can be compared in the group of patients that suffer vs. the group of patients that does not suffer from DCI.

Figure 2.

Algorithm of part 2 of the study, performed on patients with acute brain injury. Patients are randomized to either the first assessment with the Montreal Cognitive Assessment (MoCA) on the (busy) intensive care unit (ICU) first and then in the (quiet) office, or to the first MoCA assessment in the office, followed by a second in the ICU. The time between first and second assessment is < 36 hours, and the neurological condition stable between assessments 1 & 2.

Supplementary digital content

Supplementary digital content 1.

Exclusion criteria for part 1 of the study.

Supplementary digital content 2.

Exclusion criteria for part 2 of the study.

Supplementary digital content 3.

Tertiary and other outcomes of interest.

Supplementary digital content 4.

Variables of the "MoCA – DCI study" that are collected, together with their definitions.

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1

Table 1: Visit schedule for the first part of the study on aSAH patients.

	Before DCI phase	**After DCI phase**	**Follow-up**
Visit	1	2	3
Time scale	48-72h after aSAH	14-28 days after aSAH; earliest day after resolution of DCI; absence of any signs of CVS/DCI	3 months ± 10 days
Patient information and consent	X[A]		
Inclusion/Exclusion criteria	X[A]		
Demographics and medical history	X[B]		
Physical examination • GCS • NIHSS • mRS • DCI	 X[B] X[B] X[A]*	 X[B] X[B] X[B] X[B]	 X[B] X[B] X[B]
Radiological examination[+] • ASPECTS	X[A]	X[A]	X[A]
Treatment and hospital course • Complications • Treatment details		 X[B] X[B]	
Neuropsychological examination • MoCA • EuroQol (EQ5D) • Home time • Shunt-dependency	 X[A] X[A]*	 X[B]	 X[B] X[B] X[A] X[B]
Sampling of biological material	None	None	None
Serious (Adverse) Events	X[A]	X[A]	X[A]

[A] = Recorded explicitly for study purpose.

[B] = Usually recorded for patient care.

* = Estimation of pre-aSAH mRS and pre-aSAH EuroQol

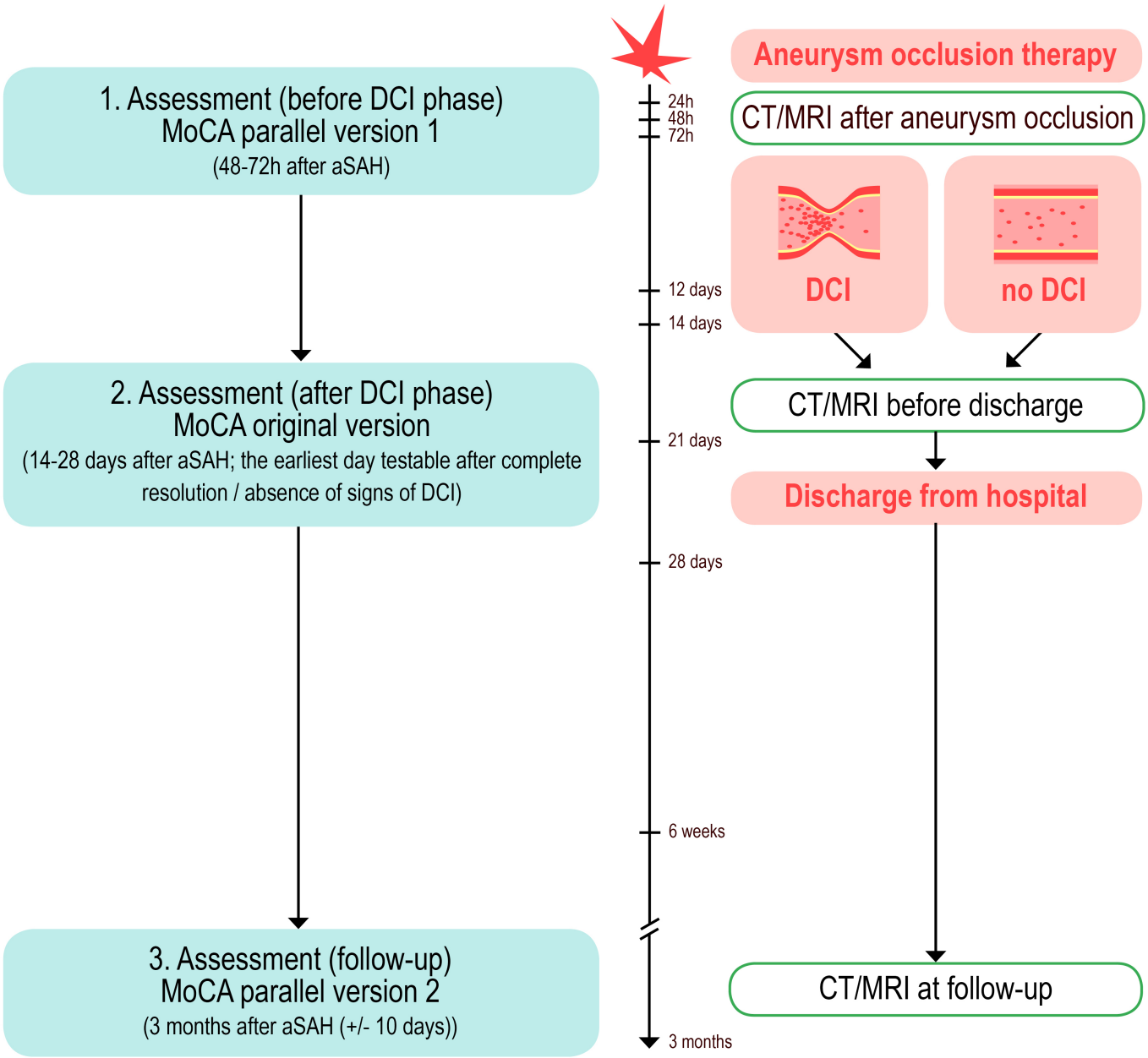
[+] = All CT-scans are performed for patient care; no CT-scans are performed explicitly for study purpose.

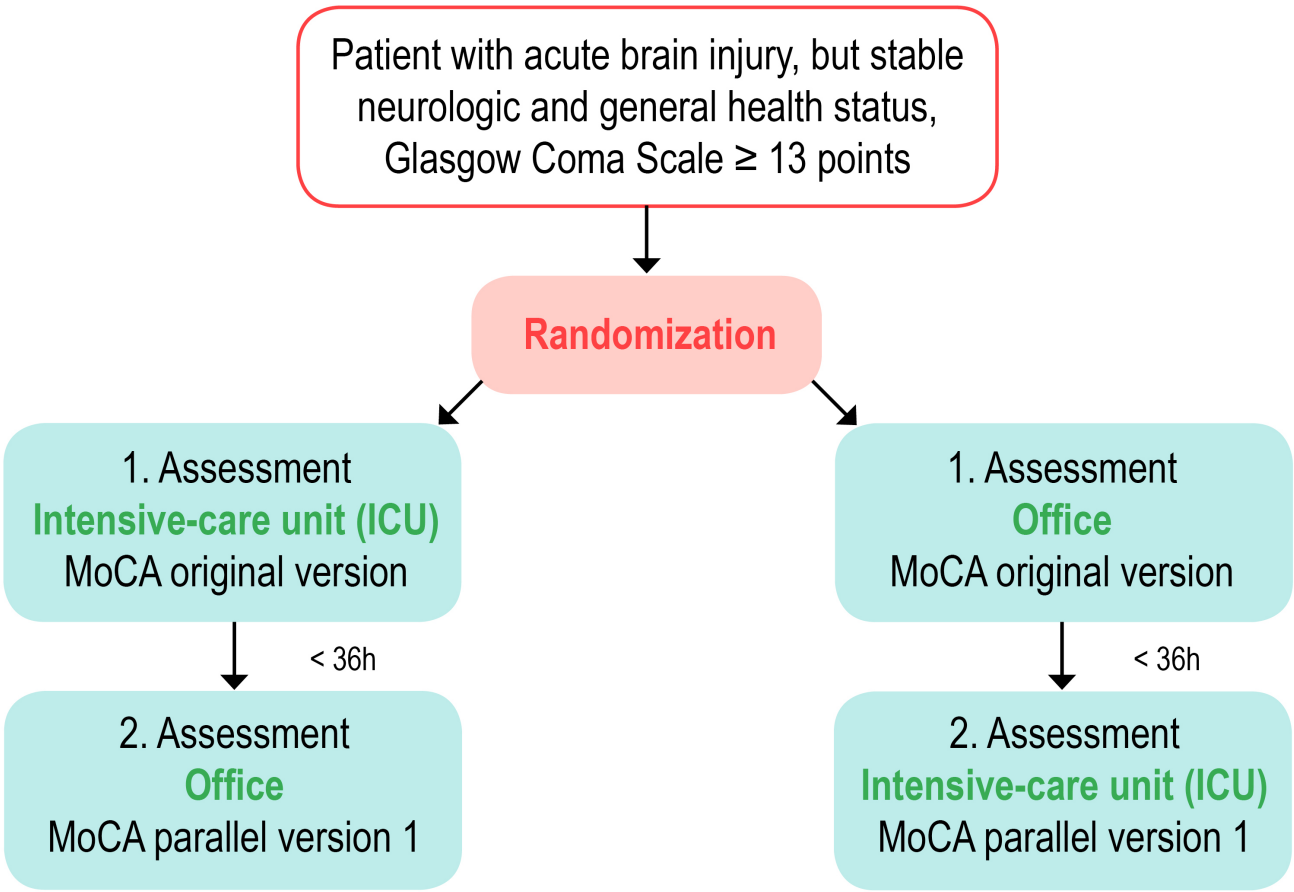
Table 2: Visit schedule for the second part of the study on patients with acute brain injury

	First assessment	**Second assessment**
Visit	1	2
Time scale	No specific time required	Within 36 hours after first assessment
Inclusion/Exclusion criteria	X[A]	
Demographics and medical history	X[B]	
Neuropsychological examination • GCS • NIHSS • mRS • MoCA • EuroQol • Random number generation	 X[B] X[B] X[B] X[A] X[A] X[A]	 X[A] X[A]
Sampling of biological material	None	None
Serious (Adverse) Events	X[A]	X[A]

[A] = recorded explicitly for study purpose.

[B] = usually recorded for patient care.


1. Assessment (before DCI phase)
MoCA parallel version 1
(48-72h after aSAH)
2. Assessment (after DCI phase)
MoCA original version
(14-28 days after aSAH; the earliest day testable after complete resolution / absence of signs of DCI)
3. Assessment (follow-up)
MoCA parallel version 2
(3 months after aSAH (+/- 10 days))
Aneurysm occlusion therapy
CT/MRI after aneurysm occlusion
DCI
no DCI
CT/MRI before discharge
Discharge from hospital
CT/MRI at follow-up
24h
48h
72h
12 days
14 days
21 days
28 days
6 weeks
3 months


Patient with acute brain injury, but stable neurologic and general health status, Glasgow Coma Scale ≥ 13 points
Randomization
1. Assessment
Intensive-care unit (ICU)
MoCA original version
< 36h
2. Assessment
Office
MoCA parallel version 1
1. Assessment
Office
MoCA original version
< 36h
2. Assessment
Intensive-care unit (ICU)
MoCA parallel version 1

Supplementary Digital Content 1.

Exclusion criteria for part 1 of the study. The presence of any one of the following exclusion criteria will lead to exclusion of the participant:

- SAH due to any other cause than aneurysm or structural abnormality of the brain (arterio-venous malformation, dural arterio-venous fistula, cavernous malformation, dissection, tumor, trauma)
- Comatose patients or patients with a reduced vigilance of GCS < 13 at time point 48h – 72h after aSAH
- No aneurysm occlusion therapy within 48h after aSAH
- Clear signs of arterial vasospasm in the initial (CT-)angiography; indicating that aSAH had occurred already several days prior to admission
- Neurologic or psychiatric diseases other than aSAH that can potentially influence the test-performance of a patient on the MoCA (e.g., dementia, multiple sclerosis, bipolar disorder)
- Foreseeable difficulties in follow-up due to geographic reasons (e.g., patients living abroad)
- Patients who are not fluent in English, German, French, or Italian
- Patients requiring sedative or other medication that would interfere with the neuropsychological evaluation
- Patients enrolled in a different clinical trial according to KlinV (participation in another research project according to HFV is allowed, if this is not a burden to the patient)

Supplementary Digital Content 2.

Exclusion criteria for part 2 of the study. The presence of any one of the following exclusion criteria will lead to exclusion of the participant:

- Instable neurological or general health-status of the patient, that makes a transport of the patient on the ICU or the office for neuropsychological testing impossible
- Suspected fluctuation of the neurological condition and the vigilance of the patient between first and second testing
- Known psychiatric disease that can potentially influence the test-performance on the MoCA (e.g., dementia, bipolar disorder)
- Patients who are not fluent in German
- Patients requiring sedative or other medication that would interfere with the neuropsychological evaluation
- Patients enrolled in a different clinical trial according to KlinV (participation in another research project according to HFV is allowed, if this is not a burden to the patient)

Supplementary Digital Content 3: Tertiary and other outcomes of interest.

Tertiary outcomes

MoCA-related

- Minimum clinically important difference (MCID) of the MoCA in patients with aSAH

Hydrocephalus-related; compared in patients that are shunt-dependent or not

- Shunt dependency at 3 months
- Absolute results of the MoCA at 48-72h, 14-28 days and 3 months
- Distribution of mRS at 3 months
- Dependency (=mRS 4&5) at 3 months
- HRQoL (Euro-Qol (EQ5D)) at 3 months
- Home time at 3 months

Aneurysm occlusion-related; compared in patients that have been treated with microsurgical or endovascular aneurysm occlusion

- Absolute results of the MoCA at 48-72h, 14-28 days and 3 months
- Distribution of mRS at 3 months
- Dependency (=mRS 4&5) at 3 months
- HRQoL as measured by the Euro-Qol (EQ5D) at 3 months in patients that have been treated with microsurgical or endovascular aneurysm occlusion
- Home time at 3 months in patients that have been treated with microsurgical or endovascular aneurysm occlusion

Other outcomes of interest (Part 2)

- Random number generation in patients with acute brain injury, especially avoidance of repetitions, counting tendency
- Test-retest reliability of random number generation in patients with acute brain injury

Supplementary Digital Content 4: Variables of the "MoCA – DCI study" that are collected, together with their definitions.

For the first part of the study, the following data is collected:

Visit 1, before DCI phase:

Name	Var_name	Type of input	Key	Definition
Age (in years)	age	Number	Min-Max; 0-120	Value for participant/subject's age, calculated as elapsed time since the birth of the participant/subject. Only whole numbers. No commas or digits.
Year of birth	YOB	Date	YYYY	Record the year of birth
Gender	gender	Binary	0=female; 1=male; 2=unknown; 3=unspecified	Self-reported gender of the participant/subject. Gender is the socially constructed identity of sex. Gender is equated with phenotypic sex. Gender may differ from the sex of an individual determined genetically. Unspecified is defined as Undifferentiated / Indeterminant / Intersex
Race	race	Categorical	0=American Indian or Alaska Native; 1=Asian; 2=Black or African-American; 3=Native Hawaiian/Pacific; 4=White; 5=Unknown; 6=Not reported	Chose the one that most closely represents the race of the participant/subject
Handedness	handedness	Categorical	0=left; 1=right; 2=forced right; 3=ambidexter; 4=unknown	Hand preference: Hand participant/subject uses predominantly. Ambidexter = uses both hands alike.
Symptom onset date	Bleed_date	Date	DD/MM/YYYY	Date reported for onset of participant's/subject's symptoms

Symptom onset time	Bleed_time	Time	MM:HH	Time reported for onset of participant's/subject's symptoms
Recruitment date	Recruit_date	Date	DD/MM/YYYY	Date of participant's/subject's study inclusion
Recruitment time	Recruit_time	Time	MM:HH	Time of participant's/subject's study inclusion
Modified Rankin scale before aSAH	Pre_aSAH_mRS	Number	Min-Max; 0-5	Modified Rankin Scale before onset of participant's/subject's symptoms
EQ5D index before aSAH (mobility)	Pre_aSAH_EQ5D_MO	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participant has problems with mobility before onset of participant's/subject's symptoms, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index before aSAH (self-care)	Pre_aSAH_EQ5D_SC	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participant has problems with self-care before onset of participant's/subject's symptoms, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index before aSAH (usual activities)	Pre_aSAH_EQ5D_UA	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participants has problems with usual activities (e.g. work, study, housework, family or leisure activities) before onset of participant's/subject's symptoms, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index before aSAH (pain/discomfort)	Pre_aSAH_EQ5D_PD	Number	Min-Max; 1(no pain)-3(exteme pain)	Category determining the extent to which the participant has problems with pain or discomfort category before onset of participant's/subject's

				symptoms, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index before aSAH (anxiety/depression)	Pre_aSAH_EQ5D_AD	Number	Min-Max; 1(no anxiety)-3(extreme anxiety)	Category determining the extent to which the participant has problems with anxiety or depression category before onset of participant's/subject's symptoms, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index before aSAH (health today scale)	Pre_aSAH_EQ5D_health	Number	Min-Max; 0 (bad) – 100 (excellent)	Scale of how good or bad the participant's health is before onset of participant's/subject's symptoms, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L)
Admission WFNS scale	Adm_WFNS	Number	Min-Max; 1-5	World Federation of Neurological Surgeons (WFNS) Grading System for Subarachnoid Hemorrhage Scale. According to Appendix 4.
Admission seizure	Adm_seizure	Binary	0=no; 1=yes	Confirmed or suspected epileptic seizure between aSAH onset and study inclusion.
Intubated at admission	Adm_intub	Binary	0=no; 1=yes	Intubated at admission.
Motor deficit	Adm_motor	Binary	0=no; 1=yes	Global assessment whether an abnormality was present following the motor exam.
Cranial nerve deficit	Adm_CN	Binary	0=no; 1=yes	Global assessment whether an abnormality was present following the cranial nerve exam.
Barrow Neurological Institute (BNI) scale	Adm_BNI	Number	Min-Max; 1-5	Defined grading of subarachnoid blood in the initial non-contrast-enhanced cranial computer-tomogram, according to Appendix 5.
Modified Fischer scale	Adm_modFischer	Number	Min-Max; 0-5	Defined grading of subarachnoid blood in the

				initial non-contrast-enhanced cranial computer-tomogram, according to Appendix 6.
Intra-ventricular hemorrhage (IVH) score	Adm_IVHscore	Number	Min-Max; 0-23	Defined grading of intraventricular blood in the initial non-contrast-enhanced cranial computer-tomogram, according to Appendix 7.
Intracerebral hemorrhage indicator	Adm_ICH	Binary	0=no; 1=yes	Indicator of a collection of confluent, relatively homogeneous blood within the brain parenchyma.
Intracerebral hemorrhage anatomic location	ICH_location	Categorical	0=undefined; 1= frontal right; 2 = frontal left; 3 = parietal right; 4 = parietal left; 5 = temporal right; 6 = temporal left; 7 = occipital right; 8 = occipital left; 9 = internal capsule right; 10 = internal capsule left; 11 = Thalamus/Basal ganglia right; 12 = Thalamus/Basal ganglia left; 13 = midbrain right; 14 = midbrain left; 15 = pons right; 16 = pons left; 17 = medulla right; 18 = medulla left; 19 = cerebellum right; 20 = cerebellum left	Anatomic site of the intracerebral hemorrhage.
Intracerebral	ICH_side	Binary	0 = left, 1 =	Laterality of intracerebral

hemorrhage laterality			right	hemorrhage
Intracerebral hemorrhage volume in ml (a x b x c / 2)	ICH_volume	Number	Min-Max; 0-300	Estimated volume of intracerebral hemorrhage in ml, using the method (a x b x c / 2)
Supratentorial midline shift indicator	MLS_indicator	Binary	0=no; 1=yes	Indicats whether midline shift is present in the supratentorial intracranial space.
Supratentorial midline shift in mm	MLS_mm	Number	Min-Max; 0-50	Maximum midline shift of the supratentorial intracranial space.
Aneurysm type	Aneur_type	Categorical	0=Saccular; 1=Fusiform; 2=Dissecting; 3=unknown	Report the type of ruptured aneurysm.
Aneurysm site	Aneur_site	Categorical	1 = ICA ophth, 2 = ICA Pcom, 3 = ICA AchoroA, 4 = ICA Bifurc, 5 = M1, 6 = MCA Bifurc, 7 = M2/M3/M4, 8 = A1, 9 = AcomA, 10 = A2/A3 and distal, 11 = Vertebral (V4), 12 = PICA, 13 = AICA, 14 = SCA, 15 = basilar trunk, 16 = basilar tip, 17 = P1/P2, 18 = P3 and distal, 19 = PcomA, 20 = AchoroA, 21 = ICA unspecified, 99 = aneurysm present, but not specified	Anatomic site of ruptured aneurysm
Aneurysm laterality	Aneur_lat	Categorical	0 = left, 1 = right, 2 = middle	Laterality of ruptured aneurysm
Aneurysm	Aneur_mult	Binary	0=no; 1=yes	Presence of multiple

multiplicity				aneurysm
Maximum diameter (in mm)	Aneur_diameter	Number	Min-Max; 1-70	Maximum diameter of ruptured aneurysm
Dome size (in mm)	Aneur_dome	Number	Min-Max; 1-70	Maximum dome size of ruptured aneurysm
Neck size (in mm)	Aneur_neck	Number	Min-Max; 1-70	Maximum neck size of ruptured aneurysm
Risk factor: arterial hypertension indicator	RF_aHT	Binary	0=no; 1=yes	Indicator of hypertension. In adults, hypertension is defined as a systolic pressure >= 140 and a diastolic >= 90.
Risk factor: tobacco smoking indicator	RF_smoke	Categorical	0 = never smoked; 1 = former smoker; 2 = current smoker; 3 = unknown	Qualitative categorization of the participant's/subject's smoking history
Risk factor: alcoholic beverages per week	RF_alcohol	Categorical	0 = none; 1 = 1-4; 2 = 5-10; 3 = 11-20; 4 = >20	Quantative categorization of the participant's/subject's consumption of alcoholic beverages
Date of neuropsychological assessment 1	Date_Npsych1	Date	DD/MM/YYYY	Date of 1st neuropsychological assessment
Time of neuropsychological assessment 1	Time_Npsych1	Date	HH:MM	Time of 1st neuropsychological assessment
Years of education	Years_education_T1	Number	Min-Max; 0-20	Sum up years of education, including primary school, secondary school, apprenticeship or university studies. Please round up (whole numbers only). The maximum of years is 20.
Headache pain at time of assessment	Headache_T1	Number	Min-Max; 0-10	The patient's / participant's headache at time of assessment is rated on the numeric rating scale from 0 (no headache) until 10 (worst headache imaginable)

NIHSS – Total Score – at time of assessment	NIHSS_T1	Number	Min-Max; 0-42	National Institute of Health Stroke Scale (NIHSS) – Total Score. It measures the severity of symptoms associated with cerebral infarcts; used as a quantitative measure of neurological deficit post stroke
GCS – Total Score – at time of assessment	GCS_T1	Number	Min-Max; 3-15	Glasgow Coma Scale (GCS) – Total Score. The GCS is a standardized instrument for assessing the level of consciousness. It evaluates three aspects of responsiveness: eye opening, motor response, verbal response. The total score is the sum of the scores for the three response types. (3-15). According to Appendix 3.
MoCA part 1: visuospatial/ executive	MoCA_T1_exe	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.
MoCA part 2: naming	MoCA_T1_nam	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 3: attention (1)	MoCA_T1_att1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 4: attention (2)	MoCA_T1_att2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 5: attention (3)	MoCA_T1_att3	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 6: language (1)	MoCA_T1_lang1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 7: language (2)	MoCA_T1_lang2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 8: abstraction	MoCA_T1_abs	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 9: delayed	MoCA_T1_rec	Number	Min-Max; 0-5	Maximum score of the participant / subject

recall				achieved for this category.
MoCA part 10: orientation	MoCA_T1_ori	Number	Min-Max; 0-6	Maximum score of the participant / subject achieved for this category.
MoCA: education ≤ 12 years	MoCA_T1_edu	Binary	0=no; 1=yes	Assign 1 extra point if participant's/subject's education is ≤ 12 years.
MoCA: total score (adjusted)	MoCA_T1_total	Number	Min-Max; 0-30	Maximum score of the participant / subject achieved (adjusted for education level).

Visit 2, after the DCI phase:

Name	Var_name	Type of input	Key	Definition
Date of discharge	Disch_date	Date	DD/MM/YYYY	Date of discharge from hospital with neurosurgical service.
Discharge type	Disch_type	Categorical	0 = rehabilitation; 1 = home; 2 = hospital; 3 = nursing home; 4 = other	Definition of where participant / subject is transferred after discharge from hospital with neurosurgical service.
Days in ICU/IMC	Days_ICU	Number	Min-Max; 0-150	Days spent at an intensive care unit (ICU) or intermediate care unit (IMC)
Days at ventilator	Days_ventilator	Number	Min-Max; 0-150	Days spent with mechanical ventilation (both invasive and noninvasive) at an intensive care unit (ICU) or intermediate care unit (IMC)
Modified Rankin scale at discharge	Disch_mRS	Number	Min-Max; 0-6	Modified Rankin Scale at discharge from hospital
Date of death (skip if no death at discharge)	Death_date	Date	DD/MM/YYYY	Date of death, in case participant / subject died during hospitalization.
Time of death (skip if no death at discharge)	Death_time	Date	HH:MM	Time of death, in case participant / subject died during hospitalization.
Motor deficit	Disch_motor	Binary	0=no; 1=yes	Global assessment whether an abnormality was present following the

				motor exam.
Cranial nerve deficit	Disch_CN	Binary	0=no; 1=yes	Global assessment whether an abnormality was present following the cranial nerve exam.
Treatment: Surgical clipping / trapping / wrapping / bypass by craniotomy	Treat_surg	Categorical	0=no; 1=yes; 2=attempt failed	Indicates whether or not any surgical treatment was performed, aiming at occluding a ruptured intracranial aneurysm by craniotomy.
Date of surgical treatment	Surg_date	Date	DD/MM/YYYY	Date of surgical treatment, in case participant / subject was treated surgically.
Treatment: Endovascular coiling / stenting / flow diversion	Treat_endovasc	Categorical	0=no; 1=yes; 2=attempt failed	Indicates whether or not any endovascular treatment was performed, aiming at occluding a ruptured intracranial aneurysm (including techniques such as coiling, stenting, flow diversion, vessel remodeling).
Date of endovascular treatment	Endov_date	Date	DD/MM/YYYY	Date of endovascular treatment, in case participant / subject was treated endovascularly.
Intraoperative or – procedural aneurysm rupture	Intraop_rupture	Categorical	0=no; 1=yes, minor; 2=yes, major; 3=unknown	Any episode of intraoperative or - procedural rupture of the ruptured aneurysm during the aneurysm occlusion procedure, whether spontaneous or as a result of microsurgical manipulation. Major - requiring blood transfusion, leading to increased intracranial pressure necessitating additional surgery (e.g. craniectomy, additional bone removal, brain resection, EVD placement), resulting in hypotension. Minor - any other rupture from any treated

				aneurysm.
Treatment: Placement of external ventricular drain (EVD)	Treat_EVD	Binary	0=no; 1=yes	Indicates whether or not an external ventricular drain (EVD) was placed for acute or chronic hydrocephalus, or during surgical treatment of the aneurysm.
Date of (initial) EVD placement	EVD_date	Date	DD/MM/YYYY	Date of EVD placement, if performed.
Treatment: Decompressive hemicraniectomy (DHC)	Treat_DHC	Binary	0=no; 1=yes	Indicates whether or not a decompressive hemicraniectomy (DHC) was performed.
Date of DHC	DHC_date	Date	DD/MM/YYYY	Date of DHC, if performed.
Treatment: Placement of ventriculo-peritoneal shunt (VPS)	Treat_VPS	Binary	0=no; 1=yes	Indicates whether or not a ventriculo-peritoneal shunt (VPS) was placed for acute or chronic hydrocephalus. Note: also other techniques of cerebro-spinal fluid diversion, such as ventriculo-atrial or –pleural are included in this definition.
Date of VPS placement	VPS_date	Date	DD/MM/YYYY	Date of VPS placement, if performed.
Treatment: Additional surgical or endovascular aneurysm occlusion therapy.	Treat_additional	Categorical	0=none; 1=surgical; 2=endovascular	This variable includes any other treatment applied during the same hospitalization for the ruptured, or any additionally discovered unruptured intracranial aneurysm.
Date of additional aneurysm occlusion therapy	Additional_date	Date	DD/MM/YYYY	Date of additional aneurysm occlusion treatment, if performed.
Treatment: prophylactic nimodipine application	Treat_nimodipine	Binary	0=no; 1=yes	This variable indicates whether or not prophylactic nimodipine was applied to the participant / subject (30-

				60mg all 4 hours, initiated within 4 days of aSAH and continued until day 21 or discharge, if earlier)
Complications: Rebleeding	Compl_rebleed	Binary	0=no; 1=yes	Sudden clinical deterioration with signs of increased hemorrhage on CT scan compared with previous CT imaging, or sudden clinical deterioration suspect for rebleeding with fresh blood in the ventricular drain in which no CT scan was obtained, or acute clinical deteriorations at the emergency department / at the CT scan before imaging was obtained. Acute clinical deterioration before admission is not taken into account.
Date of rebleeding	Rebleed_date	Date	DD/MM/YYYY	Date of first diagnosis of rebleeding, if occurred.
Complications: Acute hydrocephalus	Compl_hydro	Binary	0=no; 1=yes	Hydrocephalus on CT or MRI, defined as a bicaudate index above the 95th percentile for age (0.16 for patients 30 years or younger, 0.18 for patients 31-50 years, 0.19 for patients 51-60 years, 0.21 for patients 61-80 years, and 0.25 for patients 81-higher years) and at least one of the following: 1) CSF drainage by lumbar puncture, lumbar drainage, ventricular drainage 2) A decrease in the level of consciousness of at least 2 points lasting for ≥1 hour.
Date of hydrocephalus	Hydro_date	Date	DD/MM/YYYY	Date of first diagnosis of hydrocephalus, if occurred.

Complications: Clinical Deterioration attributable to Delayed cerebral ischemia (DCI)	Compl_clinDCI	Binary	0=no; 1=yes	The occurrence of focal neurological impairment (such as hemiparesis, aphasia, apraxia, hemianopia, or neglect), or a decrease of at least 2 points on the Glasgow Coma Scale (either on the total score or on one of its individual components [eye, motor on either side, verbal]). This should last for at least 1 hour, is not apparent immediately after aneurysm occlusion, and cannot be attributed to other causes by means of clinical assessment, CT or MRI scanning of the brain, and appropriate laboratory studies. Of note: in case DCI is suspected with predominant involvement of the anterior cerebral artery, e.g. in patients showing distinct changes of the personality such as disinhibition, inhibition, aggressive or sexist behavior that occurs in the DCI phase and was not present before the DCI phase, this can also be considered a focal neurological impairment due to DCI.
Date of Clinical Deterioration attributable to Delayed cerebral ischemia (DCI)	clinDCI_date	Date	DD/MM/YYYY	Date of first diagnosis of clinical deterioration attributable to DCI, if occurred.
Complications: DCI with predominant involvement	Compl_clinDCI_anterior	Binary	0=no; 1=yes	DCI with predominant involvement of the anterior cerebral artery is defined as a patient

of the anterior cerebral artery				showing distinct changes of the personality such as disinhibition, inhibition, aggressive or sexist behavior that occurs in the DCI phase and was not present before the DCI phase. This is considered as focal neurological impairment of the anterior cerebral artery territory, due to DCI.
Date of DCI with predominant involvement of the anterior cerebral artery	clinDCI_anterior_date	Date	DD/MM/YYYY	Date of first diagnosis of clinical deterioration attributable to DCI with predominant involvement of the anterior cerebral artery, if occurred.
Complications: Cerebral infarction attributable to Delayed cerebral ischemia (DCI)	Compl_radiolDCI	Binary	0=no; 1=yes	Cerebral infarction should be identified on CT or MR scan of the brain within 6 weeks after aSAH, or on the latest CT or MR scan made before death within 6 weeks after aSAH, or proven at autopsy. They should not have been present on CT or MR scan performed between 24 and 48 h after aneurysm occlusion, if performed. They should not be able to be attributed to other causes (e.g., surgical clipping or endovascular treatment). Hypodensities on CT imaging resulting from ventricular catheter or intraparenchymal hematoma should not be regarded as cerebral infarctions attributable to DCI.
Date of Cerebral infarction attributable to Delayed	radiolDCI_date	Date	DD/MM/YYYY	Date of first diagnosis of cerebral infarction attributable to DCI, if occurred.

cerebral ischemia (DCI)				
Complications: Cerebral vasospasm (CVS) requiring induced hypertension (grade 1)	Compl_CVS_1	Binary	0=no; 1=yes	Presence of cerebral vasospasm (CVS) confirmed by transcranial Doppler (TCD) or (CT-) angiography that require induced hypertension with crystalloid infusion or application of vasoactive drugs (e.g., noradrenaline)
Date of CVS (grade 1)	CVS_1_date	Date	DD/MM/YYYY	Date of first diagnosis of grade 1 CVS (and initiated treatment)
Complications: Cerebral vasospasm (CVS) requiring medical endovascular treatment (grade 2)	Compl_CVS_2	Binary	0=no; 1=yes	Presence of cerebral vasospasm (CVS) confirmed by transcranial Doppler (TCD) or (CT-) angiography that require endovascular treatment with intra-arterial drug installation (e.g. nimodipine, papaverine).
Date of CVS (grade 2)	CVS_2_date	Date	DD/MM/YYYY	Date of first diagnosis of grade 2 CVS (and initiated treatment)
Complications: Cerebral vasospasm (CVS) requiring mechanical endovascular treatment (grade 3)	Compl_CVS_3	Binary	0=no; 1=yes	Presence of cerebral vasospasm (CVS) confirmed by transcranial Doppler (TCD) or (CT-) angiography that require mechanical endovascular treatment with balloon / stent dilatation.
Date of CVS (grade 3)	CVS_3_date	Date	DD/MM/YYYY	Date of first diagnosis of grade 3 CVS (and initiated treatment)
Complications: Meningitis/ventriculitis	Compl_men_ventr	Binary	0=no; 1=yes	Presence of meningitis or ventriculitis defined as: • A positive cerebrospinal fluid culture • In addition to one of the following: o Fever > 38°C o Increased white blood cells, elevated

				protein or decreased glucose in cerebrospinal fluid o Positive Gram stain of cerebrospinal fluid
Date of Meningitis/ventricilitis	Men_ventr_date	Date	DD/MM/YYYY	Date of first diagnosis of meningitis/ventriculitis (and initiated treatment)
Complication: Infection	Compl_infect	Categorical (multiple choice)	0=none; 1=cerebral; 2=pulmonary; 3=urinary; 4=other	Indicates, whether and in which location(s) bacterial infections were diagnosed that required antibiotic treatment during hospitalization.
Date of infection	Infect_date	Date	DD/MM/YYYY	Date of first diagnosis of infection (and initiated treatment)
Complication: Cardiac/pulmonary complication	Compl_cardiac	Categorical (multiple choice)	0=none; 1=cardiomyopathy; 2=infarction; 3=pulmonary embolism; 4=other	Indicates, whether and what type(s) of cardiac / pulmonary complications were diagnosed during hospitalization.
Date of cardiac complication	Cardiac_date	Date	DD/MM/YYYY	Date of first diagnosis of cardiac complication (and initiated treatment)
Complication: Epileptic seizure	Compl_seizure	Binary	0=no; 1=yes	Indicates, whether an epileptic seizure was diagnosed during hospitalization, requiring anti-epileptic drug treatment.
Date of epileptic complication	Seizure_date	Date	DD/MM/YYYY	Date of first diagnosis of epileptic seizure (and initiated treatment)
Complication: Electrolyte disorder	Compl_Elyte	Categorical (multiple choice)	0=none; 1=diabetes insipidus; 2=cerebral salt wasting syndrome; 3=syndrome of inappropriate antidiuretic hormone secretion; 4=other	Indicates, whether and what type of electrolyte disorder was diagnosed during hospitalization. Of note: only disorders of the sodium homeostasis are recorded.

Date of electrolyte disorder	Elyte_date	Date	DD/MM/YYYY	Date of first diagnosis of electrolyte disorder (and initiated treatment).
Date of neuropsychological assessment 2	Date_Npsych2	Date	DD/MM/YYYY	Date of 2nd neuropsychological assessment
Time of neuropsychological assessment 2	Time_Npsych2	Date	HH:MM	Time of 2nd neuropsychological assessment
Headache pain at time of assessment	Headache_T2	Number	Min-Max; 0-10	The patient's / participant's headache at time of assessment is rated on the numeric rating scale from 0 (no headache) until 10 (worst headache imaginable)
NIHSS – Total Score – at time of assessment	NIHSS_T2	Number	Min-Max; 0-42	NIHSS – Total Score. It measures the severity of symptoms associated with cerebral infarcts; used as a quantitative measure of neurological deficit post stroke
GCS – Total Score – at time of assessment	GCS_T2	Number	Min-Max; 3-15	GCS – Total Score. The GCS is a standardized instrument for assessing the level of consciousness. It evaluates three aspects of responsiveness: eye opening, motor response, verbal response. The total score is the sum of the scores for the three response types. (3-15). According to Appendix 3.
MoCA part 1: visuospatial/ executive	MoCA_T2_exe	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.
MoCA part 2: naming	MoCA_T2_nam	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 3: attention (1)	MoCA_T2_att1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 4: attention	MoCA_T2_att2	Number	Min-Max; 0-1	Maximum score of the participant / subject

(2)				achieved for this category.
MoCA part 5: attention (3)	MoCA_T2_att3	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 6: language (1)	MoCA_T2_lang1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 7: language (2)	MoCA_T2_lang2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 8: abstraction	MoCA_T2_abs	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 9: delayed recall	MoCA_T2_rec	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.
MoCA part 10: orientation	MoCA_T2_ori	Number	Min-Max; 0-6	Maximum score of the participant / subject achieved for this category.
MoCA: education ≤ 12 years	MoCA_T2_edu	Binary	0=no; 1=yes	Assign 1 extra point if participant's/subject's education is ≤ 12 years.
MoCA: total score (adjusted)	MoCA_T2_total	Number	Min-Max; 0-30	Maximum score of the participant / subject achieved (adjusted for education level).

Visit 3, 3 months follow-up:

Name	Var_name	Type of input	Key	Definition
Date of outcome assessment	M3_date	Date	DD/MM/YYYY	Date of 3 months outcome assessment.
Modified Rankin scale at 3 months	M3_mRS	Number	Min-Max; 0-6	Modified Rankin Scale at 3 months post aSAH.
NIHSS – Total Score – at time of assessment	NIHSS_T3	Number	Min-Max; 0-42	NIHSS – Total Score. It measures the severity of symptoms associated with cerebral infarcts; used as a quantitative measure of neurological deficit post stroke
GCS – Total Score – at time of assessment	GCS_T3	Number	Min-Max; 3-15	GCS – Total Score. The GCS is a standardized instrument for assessing the level of consciousness. It evaluates three aspects of responsiveness: eye

				opening, motor response, verbal response. The total score is the sum of the scores for the three response types. (3-15). According to Appendix 3.
EQ5D index at 3 months (mobility)	M3_EQ5D_MO	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participant has problems with mobility at 3 months post aSAH, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at 3 months (self-care)	M3_EQ5D_SC	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participant has problems with self-care at 3 months post aSAH, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at 3 months (usual activities)	M3_EQ5D_UA	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participants has problems with usual activities (e.g. work, study, housework, family or leisure activities) at 3 months post aSAH, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at 3 months (pain/discomfort)	M3_EQ5D_PD	Number	Min-Max; 1(no pain)-3(exteme pain)	Category determining the extent to which the participant has problems with pain or discomfort category at 3 months post aSAH, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at 3 months (anxiety/depression)	M3_EQ5D_AD	Number	Min-Max; 1(no anxiety)-3(extreme anxiety)	Category determining the extent to which the participant has problems with anxiety or depression category at 3 months post aSAH, as part of the European Quality of Life

				Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at 3 months (health today scale)	M3_EQ5D_health	Number	Min-Max; 0 (bad) – 100 (excellent)	Scale of how good or bad the participant's health is at 3 months post aSAH, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L)
Shunt dependency at 3 months	M3_shunt	Binary	0=no; 1=yes	Shunt-dependent hydrocephalus is defined as clinical symptoms of hydrocephalus (decreased mental status, axial rigidity, and incontinence) with radiographic evidence of enlarged ventricles or a high opening pressure on repeated lumbar punctures requiring the insertion of a VP shunt for CSF diversion. Ventriculo-atrial shunt (VA shunt) or endoscopic third ventriculostomy (ETV) is also recorded, if used as alternative for shunt insertion.
Home time at 3 months	M3_hometime	Number	Min-Max; 0-120	Length of time spent in own home or relative's home in days (e.g., 65).
Date of neuropsychological assessment 3	Date_Npsych3	Date	DD/MM/YYYY	Date of 3rd neuropsychological assessment
Time of neuropsychological assessment 3	Time_Npsych3	Date	HH:MM	Time of 3rd neuropsychological assessment
Headache pain at time of assessment	Headache_T3	Number	Min-Max; 0-10	The patient's / participant's headache at time of assessment is rated on the numeric rating scale from 0 (no headache) until 10 (worst headache imaginable)
MoCA part 1: visuospatial/	MoCA_T3_exe	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.

executive				
MoCA part 2: naming	MoCA_T3_nam	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 3: attention (1)	MoCA_T3_att1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 4: attention (2)	MoCA_T3_att2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 5: attention (3)	MoCA_T3_att3	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 6: language (1)	MoCA_T3_lang1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 7: language (2)	MoCA_T3_lang2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 8: abstraction	MoCA_T3_abs	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 9: delayed recall	MoCA_T3_rec	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.
MoCA part 10: orientation	MoCA_T3_ori	Number	Min-Max; 0-6	Maximum score of the participant / subject achieved for this category.
MoCA: education ≤ 12 years	MoCA_T3_edu	Binary	0=no; 1=yes	Assign 1 extra point if participant's/subject's education is ≤ 12 years.
MoCA: total score (adjusted)	MoCA_T3_total	Number	Min-Max; 0-30	Maximum score of the participant / subject achieved (adjusted for education level).

CT-scan data, before DCI phase:

Name	Var_name	Type of input	Key	Definition
CT date	CT_T1_date	Date	DD/MM/YYYY	Date of CT scan before DCI phase
CT time	CT_T1_time	Time	MM:HH	Time of CT scan before DCI phase
ASPECT subscore for vascular territory: Left anterior cerebral	T1_LA1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left anterior cerebral artery (Part 1); see image for guidance.

artery (Part 1)				
ASPECT subscore for vascular territory: Left anterior cerebral artery (Part 2)	T1_LA2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left anterior cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 1)	T1_LM1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 2)	T1_LM2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 3)	T1_LM3_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 3); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 4)	T1_LM4_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 4); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part	T1_LM5_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 5); see image for guidance.

5)				
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 6)	T1_LM6_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 6); see image for guidance.
ASPECT subscore for vascular territory: Left caudate nucleus	T1_LCN_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left caudate nucleus; see image for guidance.
ASPECT subscore for vascular territory: Left lentiform nucleus	T1_LL_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left lentiform nucleus; see image for guidance.
ASPECT subscore for vascular territory: Left internal capsule	T1_LI_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left internal capsule; see image for guidance.
ASPECT subscore for vascular territory: Left insular cortex	T1_LIC_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left insular cortex; see image for guidance.
ASPECT subscore for total vascular territories of the left anterior circulation	T1_Aspect_total_L	Number	Min-Max; 0-12	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the left anterior circulation
ASPECT subscore for vascular territory: Right anterior cerebral artery (Part	T1_RA1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right anterior cerebral artery (Part 1); see image for guidance.

1)				
ASPECT subscore for vascular territory: Right anterior cerebral artery (Part 2)	T1_RA2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right anterior cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 1)	T1_RM1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 2)	T1_RM2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 3)	T1_RM3_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 3); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 4)	T1_RM4_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 4); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part	T1_RM5_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 5); see image for guidance.

5)				
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 6)	T1_RM6_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 6); see image for guidance.
ASPECT subscore for vascular territory: Right caudate nucleus	T1_RCN_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right caudate nucleus; see image for guidance.
ASPECT subscore for vascular territory: Right lentiform nucleus	T1_RL_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right lentiform nucleus; see image for guidance.
ASPECT subscore for vascular territory: Right internal capsule	T1_RI_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right internal capsule; see image for guidance.
ASPECT subscore for vascular territory: Right insular cortex	T1_RIC_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right insular cortex; see image for guidance.
ASPECT subscore for total vascular territories of the right anterior circulation	T1_Aspect_total_R	Number	Min-Max; 0-12	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the right anterior circulation
ASPECT subscore for vascular territory: Left thalamus	T1_Lthalamus	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left thalamus; see image for guidance.

ASPECT subscore for vascular territory: Left cerebellum	T1_Lcerebellum	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left cerebellum; see image for guidance.
ASPECT subscore for vascular territory: Left posterior cerebral artery	T1_LPCA	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left posterior cerebral artery; see image for guidance.
ASPECT subscore for vascular territory: Right thalamus	T1_Rthalamus	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right thalamus; see image for guidance.
ASPECT subscore for vascular territory: Right cerebellum	T1_Rcerebellum	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right cerebellum; see image for guidance.
ASPECT subscore for vascular territory: Right posterior cerebral artery	T1_RPCA	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right posterior cerebral artery; see image for guidance.
ASPECT subscore for vascular territory: Midbrain	T1_midbrain	Binary	0=no; 2=yes	Indicates, whether ischemic lesion present in the following vascular territory: Midbrain; see image for guidance.
ASPECT subscore for vascular territory: Pons	T1_pons	Binary	0=no; 2=yes	Indicates, whether ischemic lesion present in the following vascular territory: Pons; see image for guidance.
ASPECT subscore for total vascular territories of the posterior	T1_Aspect_pc_total	Number	Min-Max; 0-10	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the posterior circulation

circulation				
ASPECT subscore for total vascular territories of the anterior circulation	T1_Aspect_ac_total	Number	Min-Max; 0-24	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the anterior circulation
ASPECT score for total vascular territories	T1_Aspect_total	Number	Min-Max; 0-34	Sum of the vascular subscores indicating ischemic lesions of all vascular territories

CT-scan data, after DCI phase:

Name	Var_name	Type of input	Key	Definition
CT date	CT_T2_date	Date	DD/MM/YYYY	Date of CT scan after DCI phase
CT time	CT_T2_time	Time	MM:HH	Time of CT scan after DCI phase
ASPECT subscore for vascular territory: Left anterior cerebral artery (Part 1)	T2_LA1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left anterior cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Left anterior cerebral artery (Part 2)	T2_LA2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left anterior cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 1)	T2_LM1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral	T2_LM2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 2); see image for guidance.

artery (Part 2)				
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 3)	T2_LM3_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 3); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 4)	T2_LM4_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 4); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 5)	T2_LM5_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 5); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 6)	T2_LM6_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 6); see image for guidance.
ASPECT subscore for vascular territory: Left caudate nucleus	T2_LCN_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left caudate nucleus; see image for guidance.
ASPECT subscore for vascular territory: Left lentiform nucleus	T2_LL_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left lentiform nucleus; see image for guidance.
ASPECT subscore for	T2_LI_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in

vascular territory: Left internal capsule				the following vascular territory: Left internal capsule; see image for guidance.
ASPECT subscore for vascular territory: Left insular cortex	T2_LIC_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left insular cortex; see image for guidance.
ASPECT subscore for total vascular territories of the left anterior circulation	T2_Aspect_total_L	Number	Min-Max; 0-12	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the left anterior circulation
ASPECT subscore for vascular territory: Right anterior cerebral artery (Part 1)	T2_RA1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right anterior cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Right anterior cerebral artery (Part 2)	T2_RA2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right anterior cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 1)	T2_RM1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral	T2_RM2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 2); see image for guidance.

artery (Part 2)				
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 3)	T2_RM3_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 3); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 4)	T2_RM4_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 4); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 5)	T2_RM5_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 5); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 6)	T2_RM6_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 6); see image for guidance.
ASPECT subscore for vascular territory: Right caudate nucleus	T2_RCN_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right caudate nucleus; see image for guidance.
ASPECT subscore for vascular territory: Right lentiform nucleus	T2_RL_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right lentiform nucleus; see image for guidance.
ASPECT	T2_RI_site	Binary	0=no; 1=yes	Indicates, whether

subscore for vascular territory: Right internal capsule				ischemic lesion present in the following vascular territory: Right internal capsule; see image for guidance.
ASPECT subscore for vascular territory: Right insular cortex	T2_RIC_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right insular cortex; see image for guidance.
ASPECT subscore for total vascular territories of the right anterior circulation	T2_Aspect_total_R	Number	Min-Max; 0-12	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the right anterior circulation
ASPECT subscore for vascular territory: Left thalamus	T2_Lthalamus	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left thalamus; see image for guidance.
ASPECT subscore for vascular territory: Left cerebellum	T2_Lcerebellum	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left cerebellum; see image for guidance.
ASPECT subscore for vascular territory: Left posterior cerebral artery	T2_LPCA	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left posterior cerebral artery; see image for guidance.
ASPECT subscore for vascular territory: Right thalamus	T2_Rthalamus	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right thalamus; see image for guidance.
ASPECT subscore for vascular territory:	T2_Rcerebellum	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right

Right cerebellum				cerebellum; see image for guidance.
ASPECT subscore for vascular territory: Right posterior cerebral artery	T2_RPCA	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right posterior cerebral artery; see image for guidance.
ASPECT subscore for vascular territory: Midbrain	T2_midbrain	Binary	0=no; 2=yes	Indicates, whether ischemic lesion present in the following vascular territory: Midbrain; see image for guidance.
ASPECT subscore for vascular territory: Pons	T2_pons	Binary	0=no; 2=yes	Indicates, whether ischemic lesion present in the following vascular territory: Pons; see image for guidance.
ASPECT subscore for total vascular territories of the posterior circulation	T2_Aspect_pc_total	Number	Min-Max; 0-10	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the posterior circulation
ASPECT subscore for total vascular territories of the anterior circulation	T2_Aspect_ac_total	Number	Min-Max; 0-24	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the anterior circulation
ASPECT score for total vascular territories	T2_Aspect_total	Number	Min-Max; 0-34	Sum of the vascular subscores indicating ischemic lesions of all vascular territories

CT-scan data, at 3-month follow-up:

Name	Var_name	Type of input	Key	Definition
CT date	CT_T3_date	Date	DD/MM/YYYY	Date of CT scan at 3 months post aSAH
CT time	CT_T3_time	Time	MM:HH	Time of CT scan at 3 months post aSAH
ASPECT subscore for vascular territory: Left anterior	T3_LA1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left anterior cerebral artery (Part 1); see

cerebral artery (Part 1)				image for guidance.
ASPECT subscore for vascular territory: Left anterior cerebral artery (Part 2)	T3_LA2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left anterior cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 1)	T3_LM1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 2)	T3_LM2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 3)	T3_LM3_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 3); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 4)	T3_LM4_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 4); see image for guidance.
ASPECT subscore for vascular territory: Left middle cerebral	T3_LM5_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 5); see image for guidance.

artery (Part 5)				
ASPECT subscore for vascular territory: Left middle cerebral artery (Part 6)	T3_LM6_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left middle cerebral artery (Part 6); see image for guidance.
ASPECT subscore for vascular territory: Left caudate nucleus	T3_LCN_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left caudate nucleus; see image for guidance.
ASPECT subscore for vascular territory: Left lentiform nucleus	T3_LL_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left lentiform nucleus; see image for guidance.
ASPECT subscore for vascular territory: Left internal capsule	T3_LI_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left internal capsule; see image for guidance.
ASPECT subscore for vascular territory: Left insular cortex	T3_LIC_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left insular cortex; see image for guidance.
ASPECT subscore for total vascular territories of the left anterior circulation	T3_Aspect_total_L	Number	Min-Max; 0-12	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the left anterior circulation
ASPECT subscore for vascular territory: Right anterior cerebral	T3_RA1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right anterior cerebral artery (Part 1); see image for guidance.

artery (Part 1)				
ASPECT subscore for vascular territory: Right anterior cerebral artery (Part 2)	T3_RA2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right anterior cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 1)	T3_RM1_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 1); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 2)	T3_RM2_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 2); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 3)	T3_RM3_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 3); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 4)	T3_RM4_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 4); see image for guidance.
ASPECT subscore for vascular territory: Right middle cerebral	T3_RM5_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 5); see image for guidance.

artery (Part 5)				
ASPECT subscore for vascular territory: Right middle cerebral artery (Part 6)	T3_RM6_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right middle cerebral artery (Part 6); see image for guidance.
ASPECT subscore for vascular territory: Right caudate nucleus	T3_RCN_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right caudate nucleus; see image for guidance.
ASPECT subscore for vascular territory: Right lentiform nucleus	T3_RL_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right lentiform nucleus; see image for guidance.
ASPECT subscore for vascular territory: Right internal capsule	T3_RI_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right internal capsule; see image for guidance.
ASPECT subscore for vascular territory: Right insular cortex	T3_RIC_site	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right insular cortex; see image for guidance.
ASPECT subscore for total vascular territories of the right anterior circulation	T3_Aspect_total_R	Number	Min-Max; 0-12	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the right anterior circulation
ASPECT subscore for vascular territory: Left	T3_Lthalamus	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left thalamus; see image for guidance.

thalamus				
ASPECT subscore for vascular territory: Left cerebellum	T3_Lcerebellum	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left cerebellum; see image for guidance.
ASPECT subscore for vascular territory: Left posterior cerebral artery	T3_LPCA	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Left posterior cerebral artery; see image for guidance.
ASPECT subscore for vascular territory: Right thalamus	T3_Rthalamus	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right thalamus; see image for guidance.
ASPECT subscore for vascular territory: Right cerebellum	T3_Rcerebellum	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right cerebellum; see image for guidance.
ASPECT subscore for vascular territory: Right posterior cerebral artery	T3_RPCA	Binary	0=no; 1=yes	Indicates, whether ischemic lesion present in the following vascular territory: Right posterior cerebral artery; see image for guidance.
ASPECT subscore for vascular territory: Midbrain	T3_midbrain	Binary	0=no; 2=yes	Indicates, whether ischemic lesion present in the following vascular territory: Midbrain; see image for guidance.
ASPECT subscore for vascular territory: Pons	T3_pons	Binary	0=no; 2=yes	Indicates, whether ischemic lesion present in the following vascular territory: Pons; see image for guidance.
ASPECT subscore for total vascular territories of	T3_Aspect_pc_total	Number	Min-Max; 0-10	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the

the posterior circulation				posterior circulation
ASPECT subscore for total vascular territories of the anterior circulation	T3_Aspect_ac_total	Number	Min-Max; 0-24	Sum of the vascular subscores indicating ischemic lesions of the vascular territories of the anterior circulation
ASPECT score for total vascular territories	T3_Aspect_total	Number	Min-Max; 0-34	Sum of the vascular subscores indicating ischemic lesions of all vascular territories

For the second part of the study, the following data is collected:

Visit 1:

Name	Var_name	Type of input	Key	Definition
Age (in years)	CG1_age	Number	Min-Max; 0-120	Value for participant/subject's age, calculated as elapsed time since the birth of the participant/subject.
Gender	CG1_gender	Binary	0=female; 1=male	Self-reported gender of the participant/subject. Gender is the socially constructed identity of sex. Gender is equated with phenotypic sex. Gender may differ from the sex of an individual determined genetically.
Type of acute brain injury	CG1_disease_type	Categorical (multiple choice)	0=traumatic brain injury; 1= hydrocephalus; 2=brain tumour; 3=stroke; 4=meningitis/infectious CNS-disease; 5=unruptured aneurysm/AVM/Cavernoma; 6=other	Indicates what type of brain injury is the reason for the in-patient care. Of note: consequences of a stroke or traumatic brain injury, such as surgical procedures (decompressive craniectomy or cranioplasty) are coded according to the underlying disease type.
Surgical treatment indicator	CG1_surg	Binary	0=female; 1=male	Indicates, whether or not the patient has received surgical treatment within the last two weeks before

				the neuropsychological assessment.
GCS – Total Score	CG1_GCS	Number	Min-Max; 3-15	Glasgow Coma Scale (GCS) - Total Score. The GCS is a standardized instrument for assessing the level of consciousness. It evaluates three aspects of responsiveness: eye opening, motor response, verbal response. The total score is the sum of the scores for the three response types. (3-15). According to Appendix 3.
NIHSS – Total Score – at time of assessment	CG1_NIHSS	Number	Min-Max; 0-42	NIHSS – Total Score. It measures the severity of symptoms associated with cerebral infarcts; used as a quantitative measure of neurological deficit post stroke
Modified Rankin scale	CG1_mRS	Number	Min-Max; 0-5	Modified Rankin Scale at time of study inclusion.
EQ5D index at study inclusion (mobility)	CG1_EQ5D_MO	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participant has problems with mobility at time of study inclusion, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at study inclusion (self-care)	CG1_EQ5D_SC	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participant has problems with self-care at time of study inclusion, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at study inclusion (usual activities)	CG1_EQ5D_UA	Number	Min-Max; 1(no problems)-3(unable)	Category determining the extent to which the participants has problems with usual activities (e.g. work, study, housework, family or leisure activities) at time of study inclusion,

				as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at study inclusion (pain/discomfort)	CG1_EQ5D_PD	Number	Min-Max; 1(no pain)-3(exteme pain)	Category determining the extent to which the participant has problems with pain or discomfort category at time of study inclusion, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at study inclusion (anxiety/depression)	CG1_EQ5D_AD	Number	Min-Max; 1(no anxiety)-3(extreme anxiety)	Category determining the extent to which the participant has problems with anxiety or depression category at time of study inclusion, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L).
EQ5D index at study inclusion (health today scale)	CG1_EQ5D_health	Number	Min-Max; 0 (bad) – 100 (excellent)	Scale of how good or bad the participant's health is at time of study inclusion, as part of the European Quality of Life Five Dimension Three Level Scale (EQ-5D-3L)
Date of neuropsychological assessment 1	Date_Npsych_CG1	Date	DD/MM/YYYY	Date of 1st neuropsychological assessment
Time of neuropsychological assessment 1	Time_Npsych_CG1	Date	HH:MM	Time of 1st neuropsychological assessment
Years of education	Years_education_CG	Number	Min-Max; 0-20	Sum up years of education, including primary school, secondary school, apprenticeship or university studies. Please round up (whole numbers only). The maximum of years is 20.
Headache pain at time of	Headache_CG1	Number	Min-Max; 0-10	The patient's / participant's headache at time of assessment is rated

assessment				on the numeric rating scale from 0 (no headache) until 10 (worst headache imaginable)
Type of location indicator	Location_CG1	Binary	0=ICU; 1=office	Indicates, whether the patient was tested in the ICU or the office environment.
Type of ICU indicator	ICU_type_CG1	Categorical	0=patient box; 1=equipment room; 2=not applicable.	In case the testing was performed on the ICU, indicates, whether the patient was tested in a patient box on the ICU or in the equipment room. If testing was performed in the office environment, select “not applicable”.
MoCA part 1: visuospatial/ executive	MoCA_CG1_exe	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.
MoCA part 2: naming	MoCA_CG1_nam	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 3: attention (1)	MoCA_CG1_att1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 4: attention (2)	MoCA_CG1_att2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 5: attention (3)	MoCA_CG1_att3	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 6: language (1)	MoCA_CG1_lang1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 7: language (2)	MoCA_CG1_lang2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 8: abstraction	MoCA_CG1_abs	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 9: delayed recall	MoCA_CG1_rec	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.
MoCA part 10: orientation	MoCA_CG1_ori	Number	Min-Max; 0-6	Maximum score of the participant / subject achieved for this category.
MoCA:	MoCA_CG1	Binary	0=no; 1=yes	Assign 1 extra point if

education ≤ 12 years	_edu			participant's/subject's education is ≤ 12 years.
MoCA: total score (adjusted)	MoCA_CG1 _total	Number	Min-Max; 0-30	Maximum score of the participant / subject achieved (adjusted for education level).
Counting (backwards) tendency	MDT_CG1_ FOD_-1	Number	Min-Max; -300-300	FOD reflects the arithmetic difference between each response and the preceding one. Thus, the response pair "2,5" yield an FOD of +3. FODs are calculated for all pairs. FOD values of +1/-1 reflect a counting strategy. FOD values of 0 represent the number of direct repetitions.
Number of direct repetition	MDT_CG1_ FOD_0	Number	Min-Max; -300-300	FOD reflects the arithmetic difference between each response and the preceding one. Thus, the response pair "2,5" yield an FOD of +3. FODs are calculated for all pairs. FOD values of +1/-1 reflect a counting strategy. FOD values of 0 represent the number of direct repetitions.
Counting tendency	MDT_CG1_ FOD_1	Number	Min-Max; -300-300	FOD reflects the arithmetic difference between each response and the preceding one. Thus, the response pair "2,5" yield an FOD of +3. FODs are calculated for all pairs. FOD values of +1/-1 reflect a counting strategy. FOD values of 0 represent the number of direct repetitions.
Global measure of randomness	MDT_CG1_ RNG_index	Number	Min-Max; -300-300	The RNG index is a global measure of randomness. As a general redundancy measure, this index is

				among the most frequently used measures of non-randomness in the literature on RNG. It varies between 0 and 1, with higher indices representing less randomness.
Frequency of shifts between ascending and descending sequences	MDT_CG1_TPI	Number	Min-Max; -300-300	The TPI captures the frequency of shifts between ascending and descending sequences. TPI is reported as a percentage score, meaning that values greater than 100 indicate too many turning points, whereas values less than 100 indicate fewer turning points than expected.
Repetition tendency at d-gram length 3 relative to tendencies at length 2	MDT_CG1_Phi3	Number	Min-Max; -300-300	The phi index provides a measure of repetition tendency over different orders of analysis (binary case).
Number of rule breaks	MDT_CG1_rule_breaks	Number	Min-Max; -300-300	A rule break is defined as the production of "out-of-category" digits such as 7, 0, or 11.
Number of skipped beats	MDT_CG1_skipped_beats	Number	Min-Max; -300-300	The total number of beats of the metronome, which were not immediately followed by a digit.
Estimated length of generated series	MDT_CG1_length	Number	Min-Max; -300-300	After the MDT the subject is asked to estimate the length of the generated series ("How many numbers did you say?")

Visit 2:

Name	Var_name	Type of input	Key	Definition
Date of neuropsychological assessment 1	Date_Npsych_CG2	Date	DD/MM/YYYY	Date of 1st neuropsychological assessment
Time of	Time_Npsyc	Date	HH:MM	Time of 1st

neuropsychological assessment 1	h_CG2			neuropsychological assessment
Headache pain at time of assessment	Headache_CG2	Number	Min-Max; 0-10	The patient's / participant's headache at time of assessment is rated on the numeric rating scale from 0 (no headache) until 10 (worst headache imaginable)
Type of location indicator	Location_CG2	Binary	0=ICU; 1=office	Indicates, whether the patient was tested in the ICU or the office environment.
Type of ICU indicator	ICU_type_CG2	Categorical	0=patient box; 1=equipment room; 2=not applicable.	In case the testing was performed on the ICU, indicates, whether the patient was tested in a patient box on the ICU or in the equipment room. If testing was performed in the office environment, select "not applicable".
MoCA part 1: visuospatial/ executive	MoCA_CG2_exe	Number	Min-Max; 0-5	Maximum score of the participant / subject achieved for this category.
MoCA part 2: naming	MoCA_CG2_nam	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 3: attention (1)	MoCA_CG2_att1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 4: attention (2)	MoCA_CG2_att2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 5: attention (3)	MoCA_CG2_att3	Number	Min-Max; 0-3	Maximum score of the participant / subject achieved for this category.
MoCA part 6: language (1)	MoCA_CG2_lang1	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part 7: language (2)	MoCA_CG2_lang2	Number	Min-Max; 0-1	Maximum score of the participant / subject achieved for this category.
MoCA part 8: abstraction	MoCA_CG2_abs	Number	Min-Max; 0-2	Maximum score of the participant / subject achieved for this category.
MoCA part	MoCA_CG2	Number	Min-Max; 0-5	Maximum score of the

9: delayed recall	_rec			participant / subject achieved for this category.
MoCA part 10: orientation	MoCA_CG2 _ori	Number	Min-Max; 0-6	Maximum score of the participant / subject achieved for this category.
MoCA: education ≤ 12 years	MoCA_CG2 _edu	Binary	0=no; 1=yes	Assign 1 extra point if participant's/subject's education is ≤ 12 years.
MoCA: total score (adjusted)	MoCA_CG2 _total	Number	Min-Max; 0-30	Maximum score of the participant / subject achieved (adjusted for education level).
Counting (backwards) tendency	MDT_CG2_ FOD_-1	Number	Min-Max; -300-300	FOD reflects the arithmetic difference between each response and the preceding one. Thus, the response pair "2,5" yield an FOD of +3. FODs are calculated for all pairs. FOD values of +1/-1 reflect a counting strategy. FOD values of 0 represent the number of direct repetitions.
Number of direct repetition	MDT_CG2_ FOD_0	Number	Min-Max; -300-300	FOD reflects the arithmetic difference between each response and the preceding one. Thus, the response pair "2,5" yield an FOD of +3. FODs are calculated for all pairs. FOD values of +1/-1 reflect a counting strategy. FOD values of 0 represent the number of direct repetitions.
Counting tendency	MDT_CG2_ FOD_1	Number	Min-Max; -300-300	FOD reflects the arithmetic difference between each response and the preceding one. Thus, the response pair "2,5" yield an FOD of +3. FODs are calculated for all pairs. FOD values of +1/-1 reflect a counting strategy. FOD values of 0 represent

				the number of direct repetitions.
Global measure of randomness	MDT_CG2_RNG_index	Number	Min-Max; -300-300	The RNG index is a global measure of randomness. As a general redundancy measure, this index is among the most frequently used measures of non-randomness in the literature on RNG. It varies between 0 and 1, with higher indices representing less randomness.
Frequency of shifts between ascending and descending sequences	MDT_CG2_TPI	Number	Min-Max; -300-300	The TPI captures the frequency of shifts between ascending and descending sequences. TPI is reported as a percentage score, meaning that values greater than 100 indicate too many turning points, whereas values less than 100 indicate fewer turning points than expected.
Repetition tendency at d-gram length 3 relative to tendencies at length 2	MDT_CG2_Phi3	Number	Min-Max; -300-300	The phi index provides a measure of repetition tendency over different orders of analysis (binary case).
Number of rule breaks	MDT_CG2_rule_breaks	Number	Min-Max; -300-300	A rule break is defined as the production of "out-of-category" digits such as 7, 0, or 11.
Number of skipped beats	MDT_CG2_skipped_beats	Number	Min-Max; -300-300	The total number of beats of the metronome, which were not immediately followed by a digit.
Estimated length of generated series	MDT_CG2_length	Number	Min-Max; -300-300	After the MDT the subject is asked to estimate the length of the generated series ("How many numbers did you say?")