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Technical feasibility of mechanical thrombectomy under conscious sedation and comprehensive evaluation of procedural complications: four years of experience with stent-retriever devices

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Azzedine Benaissa, Sebastien Soize, Isabelle Serre, Laurent Pierot

Abstract

INTRODUCTION: Mechanical thrombectomy (MT) with stent-retrievers is increasingly used in acute ischemic stroke (AIS) treatment. Because patients undergoing such interventions typically do not cooperate, conscious sedation or general anesthesia is required. This study aims to analyse the technical feasibility and efficacy of MT under conscious sedation with a particular emphasis on procedural complications.

METHODS: Consecutive patients with AIS who underwent MT with a stent-retriever from May 2010 to March 2014 at our center were prospectively included. Clinical and imaging data from presentation to 3-months were collected. Technical feasibility of MT, efficacy, safety and intra-procedural complications were reported. We also compared outcomes between agitated and calm patients.

RESULTS: Among 103 patients intended to treat, 92 underwent MT under conscious sedation. MT was feasible in 83/92 patients (90.2 %). Successful (TICI≥2b) and partial or complete revascularisation (TICI≥2a) was achieved in 46/92 (50.0 %) and 56/92 (60.9 %) patients respectively. Procedural complications were: agitation in 17/92 (18.5 %), haemodynamic instability in 8/92 (8.7 %), respiratory failure in 2/92 (2.2 %), arterial dissection in 2/92 (2.2 %), and inhalation pneumonia in 3/92 (3.3 %). At 3 months, 44/92 patients (47.8 %) had a good neurological outcome (mRS≤2), mortality was 20.7 % (19/92) and symptomatic haemorrhage rate 7.6 % (7/92). Feasibility was lower in agitated than non-agitated patients (64.7 % vs 96.5 %, p=0.0005).

CONCLUSION: MT under conscious sedation is feasible in most cases (90.2 %) with acceptable clinical and angiographic results. The frequency of procedure-related complications lies within acceptable limits for an emergency procedure. Technical feasibility decreases when the patient is agitated (64.7 %).

Keywords: stroke, thrombectomy, endovascular, sedation, anesthesia

Abbreviation Key

CCA	common carotid artery
AIS	acute ischemic stroke
ASPECTS	alberta stroke program early computerised tomography score
CT	computerised tomography

Azzedine Benaissa, MD (Corresponding Author) — Department of Radiology, Hôpital Maison Blanche, 45 Rue Cognacq-Jay, 51092 Reims, France *Tel:* +33 (0)326787566 *Fax:* +33 (0)326787594 *Email:* azben91@yahoo.fr

Sebastien Soize, MD — Department of Radiology, Hôpital Maison Blanche, Université de Champagne-Ardenne, CHU de Reims, Reims, France

Isabelle Serre, MD — Department of Neurology, Hôpital Maison Blanche, Université de Champagne-Ardenne, CHU de Reims, Reims, France

Laurent Pierot, MD PhD — Department of Radiology, Hôpital Maison Blanche, Université de Champagne-Ardenne, CHU de Reims, Reims, France

ICA	internal carotid artery
ICH	intracranial haemmorrhage
IV	intravenous
MCA	middle cerebral artery
MT	mechanical thrombectomy
MRI	magnetic resonance imaging
mRS	modified rankin scale
NIHSS	National Institue of Health Stroke Scale
SHA	subarachnoid haemmorrhage
sICH	symptomatic intracranial haemmorrhage
TICI	thrombolysis in cerebral infarction score
tPA	tissue plasminogen activator

Introduction

Intra-venous (IV) thrombolysis using rt-PA is now the gold standard treatment for patients with acute ischemic stroke (AIS), with an enlargement of the time window from 3 to 4.5 h [1]. Assuming that recanalisation of the occluded artery is the most powerful predictor of outcome in acute ischemic stroke, endovascular management of AIS with mechanical thrombectomy (MT) has emerged as a new approach and is being used with increasing frequency [2]. The utilisation of second generation MT devices (stent-retrievers) has shown better recanalisation rates and functional outcomes than first generation devices [3-4]. Patients undergoing acute stroke interventions typically do not cooperate with the procedure, due to the severity of neurologic injury and alterations in the sensorium. Therefore, conscious sedation or general anesthesia with intubation is typically required to perform MT. The choice to use sedation or general anesthesia is specific to each center and presently there is no evidence on the best approach [5-6]. However, several studies have reported better neurological outcome when patients were treated under conscious sedation and with similar safety [7-12]. Though important to the eventual procedural outcome, no data regarding intra-procedural complications related to the MT performed on awakened patients (conscious sedation) is available for any of the endovascular stroke therapy trials conducted to date [13-14]. The aim of our study is to analyse the technical feasibility and efficacy of MT performed under conscious sedation (without anesthesiologist) with a particular emphasis on occurrence of procedural complications.

Material and method

Patient selection

All consecutive patients with AIS who underwent mechanical thrombectomy with a stent-retriever from May 2010 to March 2014 were prospectively included in our institutional stroke database according to a protocol approved by the local Institutional Review Board. Medical history, as well as clinical and imaging data, was retrospectively analysed from symptom onset through to a 3-month follow-up visit. According to the study design, individual patient consent was waived. Data from the first 59 patients have been

published as part of a previous study which concerned the predictive factors of outcome and haemorrhage after AIS treated by MT [15].

Medical history and clinical data

During hospitalisation the following data were collected: age, gender, medical history of smoking, hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation, previous cardiovascular events (including stroke, coronary disease or ischemic cardiomyopathy, peripheral arterial disease) and cancer. On admission, clinical data collected were: hemisphere dominance (hemisphere stroke was defined as dominant if the patient had aphasia), the National Institute of Health Stroke Score (NIHSS), presence of atrial fibrillation on the electrocardiogram, the level of glycaemia (mmol/L), intravenous thrombolysis. Neurologic functional outcome at 3 months was measured using the modified Rankin Scale (mRS) and the NIHSS by an independent neurologist: mRS at 3 months ≤2 was defined as good. Stroke etiology was assessed using Trial of Org 10172 in Acute Stroke Treatment classification [16].

Thrombectomy treatment

According to our institutional protocol, patients were treated immediately with MT if they were ineligible for intravenous tissue-type plasminogen activator (tPA) or transferred to the angio suite and treated after approximate 30 min if they did not clinically improve (decrease of 10 points on NIHSS or NIHSS becoming ≤8) after receiving IV tPA (0.9 mg/kg). Anterior circulation strokes were treated up to 6 h from symptoms onset and posterior circulation strokes up to 24 h. All procedures were done with the Solitaire FR device (ev3/Covidien). Conscious sedation consisted of an intravenous injection of 1 mg of midazolam before the procedure. The patient was defined as agitated if at least 1 supplementary injection of midazolam was needed during the procedure. MT was defined as feasible if at least 1 Solitaire device could be deployed. Intra-arterial tPA was allowed as an adjunct to thrombectomy on a case by case basis. Carotid angioplasty or stenting was allowed in cases of proximal stenosis or occlusion preventing distal recanalisation. Initial and final intra-cranial flow was graded using the Thrombolysis In Cerebral Infarction (TICI) scale [17]. Successful revascularisation was defined as TICI≥2b and partial or complete recanalisation as TICI≥2a. During the procedure, the following events were noted: the number of stent deployments, patient agitation, haemodynamic instability (defined by systolic blood pressure≥180 mmHg and/or diastolic blood pressure≥ 110 mmHg) and post-procedure intubation due to clinical worsening. Complications occurring during the procedure were also assessed.

Imaging protocol

Imaging data were evaluated by an independent neuroradiologist blinded from clinical and angiographic data. All patients underwent an acute 3-T magnet MRI (Philips Achieva 2.1, Best, The Netherlands) before thrombectomy unless contraindicated. In case of contraindication to MRI, a head CT and CTA were performed. For MR imaging, a standardised imaging protocol was used, including DWI, fluid-attenuated inversion recovery (FLAIR), T2* gradient-recall echo sequences, and if necessary, an intracranial time-of-flight MRA completed by an intracranial and/or cervical gadolinium enhanced MR angiography. No perfusion weighted imaging was acquired. In order to evaluate the extension of the ischemic lesion on diffusion-weighted images, the ASPECTS and pc-ASPECTS were used [18-20]. Images indicative of a former stroke were noted. Occlusion sites were divided as follows: middle cerebral artery (MCA), internal carotid

artery (ICA), ICA/MCA tandem occlusion and basilar artery. Leukoaraiosis was assessed on FLAIR MR Images and dichotomised as absent or mild (Fazekas 0–1) versus moderate or severe (Fazekas 2–3), using the visual rating scale proposed by Fazekas and Schmidt [21]. A susceptibility vessel sign was defined as an enlarged proximal artery with hyposignal area on the T2* GRE sequence.

All patients underwent an unenhanced head CT scan at 24 h (or earlier when rapid neurological deterioration occurred). An intracranial haemmorrhage (ICH) was defined as a parenchymal haematoma type 2 (PH-2) from the European Cooperative Acute Stroke Study or a subarachnoid haemorrhage (SAH) [22]. A symptomatic intracranial haemorrhage (sICH) was defined as any ICH causing neurological deterioration (defined as an increase of ≥4 points of the NIHSS).

Timing data

The time from symptom onset to endovascular procedure (defined by the first angiographic run), the duration of the endovascular procedure (from the first to the last angiographic run) and time from symptom onset to recanalisation were calculated for each patient.

Statistical analysis

Quantitative variables were described as mean ± standard deviation, median and range, while qualitative variables were described as numbers and percentages. Categorical variables and quantitative variables were compared between agitated and non-agitated patients using Mann–Whitney tests or Fisher's exact tests as appropriate, including the feasibility rate of MT. Multivariate logistic regression analysis was performed to determine factors on admission independently associated with agitation during the procedure using variables with $P<0.10$ on univariate analysis, which were considered to be potential factors associated with agitation. A two-sided p value of less than 0.05 was considered significant. Analyses were conducted using MedCalc statistical software (11.4.3.0; MedCalc Software, Mariakerke, Belgium).

Results

Patient characteristics

From May 2010 to March 2014, 103 patients with AIS large vessel occlusion were treated at our institution with a stent-retriever. Among them, 3 patients (2.9 %) recanalised spontaneously without any intervention and 8 patients (7.8 %) arrived intubated due to alteration of the level of consciousness and were treated under general anaesthesia. Finally, 92 patients were treated under conscious sedation with a stent-retriever. Among these 92 patients, 17 were agitated (18.5 %) (injection of 2 mg to 13 mg of midazolam). The baseline clinical and imaging characteristics of patients treated under conscious sedation are summarised in Tables 1 and 2 respectively.

Treatment feasibility and efficacy

MT was feasible in 83/92 patients (90.2 %) overall, and in 40/42 subjects with dominant hemisphere stroke (95.2 %). Among the 9 patients who could not be treated, 4 patients (4.4 %) underwent the first angiogram

run but the intracranial occlusion was not reached due to excessive tortuosity of cervical vessels precluding device delivery (1 agitated and 3 non-agitated patients). The 5 other patients (5.4 %) were agitated despite supplementary injections of midazolam, necessitating the interruption of the procedure. Technical feasibility was lower in agitated compared to non-agitated patients (11/17 (64.7 %) vs 82/85 (96.5 %), P=0.0005).

Mean time from symptom onset to endovascular treatment was 259 ± 114.8 min (median 255, range 115-1110). The duration of the procedure was 45.9 ± 25.4 min (median 42, range 10-130). The mean time from symptom onset to recanalisation was 304.5 ± 121.1 min (median 295, range 125-1200). In intention-to-treat, successful revascularisation (TICI ≥2b) was achieved in 46/92 patients (50.0 %) and partial or complete recanalisation (TICI ≥ 2a) in 56/92 patients (60.9 %). With a per-procedure analysis, 46/83 patients (55.4 %) were TICI ≥ 2b and 56/83 patients (67.5 %) were TICI ≥ 2a. The mean number of stent deployments was 1.7 ± 1.1 per procedure (median 1, range 0-7). Among the 92 patients, 44 subjects (47.8 %) presented a good neurological outcome (mRS≤2). At 3 months, mean NIHSS score was 10.1 ± 9.3 (median 7.5, range 0-30). Concerning haemorrhagic events at day 1, 14/92 (15.2 %) patients had ICH of which 7/92 (7.6 %) were sICH. The overall mortality rate at 3 months was 20.7 % (19/92). There were 9/92 (9.8 %) fatal outcomes due to extensive brain infarction with intracranial hypertension, 7/92 (7.6 %) patients died due to symptomatic ICH and other aetiologies in 3/92 (3.3 %) subjects.

For the 17 agitated patients, the duration of the procedure was 54.2 ± 31.1 min (median 60, range 12-120). Successful revascularisation (TICI ≥ 2b) and partial or complete recanalisation (TICI ≥ 2a) were achieved in 6/17 (35.3%) and 7/17 (41.2 %) patients respectively. The mean number of stent deployments was 1.7 ± 0.8 per procedure (median 2, range 0-3). At 3 months, 5/17 patients (29.4 %) showed good functional outcome (mRS ≤ 2), mean NIHSS score was 17.0 ± 5.2 (median 20, range 0-29). Regarding haemorrhagic events at day 1, 5/17 patients (29.4 %) had ICH of which 3 (17.6 %) were symptomatic. The overall mortality rate at 3 months was 35.3 % (5/17 patients).

Though not significant, there was a trend for agitated patients to have longer procedures (54.2 ± 31.1 vs 44.1 ± 26.3 min, P= 0.17), more haemodynamic instability (17.6 % vs 6.7 %, P=0.16), less recanalisation (for TICI≥2a, 41.2% vs 65.3%, P=0.09), worse neurological outcome (29.4 % vs 52.0 %, P=0.11), higher mortality (35.3 % vs 17.3 %, P=0.10) and symptomatic haemorrhage rate (17.6 % vs 5.3 %, P=0.11).

The proportion of dominant hemisphere strokes in agitated patients (10/17) did not statistically differ from the proportion of dominant hemisphere strokes in non-agitated patients (32/75) (p=0.23). Table 3 shows the comparison of baseline, procedural and post-procedural variables between agitated and non-agitated patients.

Peri-procedural complications

A total of 8/92 patients (8.7 %) had haemodynamic instability during the procedure. Among them, 2 patients presented with sICH at day 1 (1 parenchymal haematoma type 2 and one SHA) both of whom had poor neurological outcome (mRS<2) at 3 months. One patient (1.1 %) with occlusion of the basilar artery presented with persistent respiratory failure which required emergency intubation during the procedure, severely delaying treatment. And 1 patient (1.1 %) with MCA occlusion presented a transitory respiratory failure that delayed intervention. Recanalisation was not obtained and the patient rapidly died from malignant cerebral oedema. Four patients were intubated just after the procedure due to alteration of

consciousness (3/64 patients with MCA occlusion and 1/6 subjects with posterior circulation occlusion). Two (2.2 %) arterial dissections related to guidewire manipulations occurred. The first occurred in the MCA segment in a non-agitated patient, revealed by contrast extravasation during the procedure; neurological evolution was poor (mRS<2). The second occurred in the petrous ICA in an agitated patient, which had a poor neurological outcome (mRS<2) despite partial recanalisation (TICI2a). Three patients (3.3 %) had emesis during the procedure, a complication of inhalation pneumonia, which resolved after antibiotic treatment in all cases (2/64 patients with MCA occlusion and 1/6 patients with posterior circulation occlusion).

Risks factors of agitation during the procedure (Table 3)

Among pre-therapeutic variables, baseline ASPECTS on DWI (5.3 ± 2.2 vs. 6.9 ± 1.8; P=0.002), baseline blood glucose level (18.5 ± 5.1 vs. 16.6 ± 5.2; P=0.04) and ICA/MCA tandem occlusion (47.1% vs. 12.0 %; P=0.002) were significantly associated with an agitated state during the procedure. The multivariate analysis showed that baseline ASPECTS (OR 0.67, CI 95 % 0.46-0.95; P=0.02) and Tandem occlusion (OR 6.20, CI 95 % 1.62-23.6; P=0.007) were independent predictors of agitation during the procedure.

Discussion

The primary aim of this study was to evaluate the feasibility, efficacy and safety of MT performed under conscious sedation. The feasibility of MT under conscious sedation was satisfactory (83/92 or 90.2 %). Technical limitations included an inability to reach the intracranial occlusion prior to 6 h from symptoms onset due to excessive tortuosity of cervical vessels in 4 patients (4.4 %) and excessive agitation necessitating the interruption of the procedure in 5 patients (5.4 %). Feasibility of the treatment in agitated patients was lower compared to non-agitated patients (70.2 % vs. 96.5 %, P=0.0005).

Regarding efficacy, the rate of good neurological outcome (44/92 patients, 47.8 %) was comparable to the literature (40.8 % to 58 %) [3-4]. But successful revascularisation (TICI ≥ 2b) and partial or complete recanalisation (TICI ≥ 2a) rates concerned 46/92 patients (50.0 %) and 56/92 patients (60.9 %) respectively, which was slightly lower than reported in the literature (61 % to 69 % for TICI ≥ 2) [3-4]. This can be explained by the intention to treat design of our study that better reflects the results obtained in daily practice than the per-procedure designed studies. Indeed, in our study all the patients intended to treat were included, even when we were unable to make 1 deployment of the device, decreasing the recanalisation rates. Using a per-procedure design, as in other reported series, our angiographic results are similar to those reported in the literature, with 46/83 patients (55.4 %) that were TICI ≥ 2b and 56/83 patients (67.5 %) that were TICI ≥ 2a. Moreover, in the present series, partial or complete recanalisation was observed in only 41.2 % of agitated patients (7/17) compared to 65.3 % (49/75) in non-agitated patients (P=0.09).

Another important concern, yet to be reported in major recent randomised trials, is the complications occurring during the procedure under conscious sedation [13-14]. Two recent studies reported that the frequency of procedure-related complications (whatever type of anaesthesia) lies within acceptable limits for an emergency procedure [23-24]. In this study, we noted more specifically the complications that can occur under conscious sedation that are usually not described in the literature. We noticed haemodynamic instability in 8/92 patients (8.7 %), transitory respiratory failure in 1/92 (1.1 %), and persistent

respiratory failure necessitating emergency intubation in 1/92 (1.1 %), arterial dissection in 2/92 (2.2 %) and emesis causing inhalation pneumonia in 3/92 (3.3 %). Some of these events delayed more or less the MT and could have been prevented with the use of general anaesthesia.

There is no high level of evidence for the best anaesthetic approach; some authors have reported that general anesthesia is associated with worse clinical outcomes during intra-arterial treatment for stroke [7-11]. Conscious sedation is easily administered and provides rapid sedation (reducing the time to recanalisation) and presumably a more stable haemodynamic; however, microcatheter navigation is often more challenging than under general anaesthesia due to patient movements. On the contrary, general anaesthesia eliminates patient movement providing easier microcatheter navigation than conscious sedation (reducing the risk of arterial perforation or dissection); however, haemodynamic alteration may occur, potentially associated with worsening the clinical outcome. In their retrospective study comparing general anaesthesia and conscious sedation in patients with anterior circulation stroke, Jumaa et al. and Abou-Chebl et al. concluded that conscious sedation (or non-intubated state) were as safe as general anaesthesia with more favourable clinical and angiographic outcomes [7-8]. Recently, the NASA Registry demonstrated that clinical outcomes and survival are significantly better in patients treated with local anaesthesia, without increased symptomatic intracranial haemorrhage risk, supporting the findings of these two previous studies [11]. Despite some limitations of these studies (e.g., retrospective nature, inclusion bias), general anaesthesia for all patients with AIS is probably not the best therapeutic option. Nonetheless, MT should be performed with the support of an anaesthesiologist who helps choose the best approach (conscious sedation or general anaesthesia) on a case-by-case basis. Whenever possible, conscious sedation is preferred and should be administered by the anaesthesiologist, with the ability to convert to general anaesthesia if necessary, such as in patients who have agitatation during the procedure. The decision of conscious sedation or general anaesthesia remains multidisciplinary and should take into account the advice of anaesthesiology, as well as the needs of the neurologist and neurointerventionist. To help make the final decision, some clinical and imaging factors can be taken into account. In the present series, patients with a large stroke volume (baseline ASPECTS: OR 0.67, CI 95 % 0.46-0.95; P=0.02) and tandem occlusion (OR 6.20, CI 95 % 1.62-23.6; P=0.007) were more restless and possibly good candidates for MT directly conducted under general anaesthesia. Indeed, the fate of agitated patients treated under conscious sedation seems to be worse than calm patients. Although not significant, agitated patients tended to have poorer neurological outcome (29.4 % vs 52.0 %, P=0.11), higher mortality (35.3 % vs 17.3 %, P=0.10) and symptomatic haemorrhage rate (17.6 % vs 5.3 %, P=0.11). These poorer outcomes can be explained first by their tendency to have higher NIHSS on admission (18.5 ± 5.1 vs 16.6 ± 5.2, P=0.17) and larger stroke volume (ASPECTS 5.3 ± 2.2 vs 6.9 ± 1.9, P=0.002). We also noticed that these patients tended to have longer procedures (54.2 ± 31.1 vs 44.1 ± 26.3 min, P= 0.17), more haemodynamic instability (17.6% vs 6.7%, P=0.16) and less recanalisation (for TICI≥2a, 41.2% vs 65.3%, P=0.09). Also, the procedural complications reported above may have contributed.

Study limitations include the fact this is a single-centre case series. The number of patients, however respectable, seems to be small to reveal some differences between groups. However, the prospective design, with clinical and MR imaging independent assessment (angiographic data evaluation was not independent, as done by the practitioner who completed the treatment). No comparison in terms of clinical outcome or recanalisation rate could be performed between posterior and anterior circulation strokes because of the small size of the population with posterior circulation stroke.

Conclusion

MT under conscious sedation is feasible in most cases (90.2 %) with acceptable clinical and angiographic results. The frequency of procedure-related complications lies within acceptable limits for an emergency procedure. However, technical feasibility is more limited when the patient is agitated (64.7 %), underlying the importance of the multidisciplinary decision and care including anesthesiologists. In this series, patients with tandem occlusion or large strokes volumes were more restless and potential good candidates for general anesthesia from the beginning of the procedure.

Conflict of interest

LP consults for Codman, Covidien/ev3, MicroVention, Penumbra and Sequent.

References

1. Hacke W, Kaste M, Bluhmki E, Brozman M, Dávalos A, Guidetti D et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. *N Engl J Med*. 2008;359:1317-29.

2. Rha JH, Saver JL. The impact of recanalisation on ischemic stroke outcome: a meta-analysis. *Stroke*. 2007; 38: 967–973.

3. Saver JL, Jahan R, Levy EI, Jovin TG, Baxter B, Nogueira RG et al; SWIFT Trialists. Solitaire flow restoration device versus the Merci Retriever in patients with acute ischaemic stroke (SWIFT): a randomised, parallel-group, non-inferiority trial. *Lancet*. 2012;380:1241-9.

4. Nogueira RG, Lutsep HL, Gupta R, Jovin TG, Albers GW, Walker GA et al. TREVO 2 Trialists. Trevo versus Merci retrievers for thrombectomy revascularisation of large vessel occlusions in acute ischaemic stroke (TREVO 2): a randomised trial. *Lancet*. 2012;380:1231-40.

5. McDonagh D, Olson DW, Kalia J, Gupta R, Abou-Chebl A, and Zaidat O. Anesthesia and sedation practices among neurointerventionalists during acute ischemic stroke endovascular therapy. *Frontiers in neurology* 2010; 2, art118.

6. Soize S, Naggara O, Desal H, Costalat V, Ricolfi F, Pierot L. Endovascular treatment of acute ischemic stroke in France: a nationwide survey. *J Neuroradiol*. 2014;41:71-9.

7. Abou-Chebl A, Lin R Hussain MS, Jovin TG, Levy EI, Liebeskind DS, et al. Conscious sedation versus general anesthesia during endovascular therapy for anterior circulation stroke: Preliminary results from a retrospective, multicenter study. *Stroke* 2010; 41:1175-1179.

8. Jumaa MA, Zhang F, Ruiz-Ares G, Gelzinis T, Malik AM, Aleu A, et al. Comparison of safety and clinical and radiographic outcomes in endovascular acute stroke therapy for proximal middle cerebral artery occlusion with intubation and general anesthesia versus the nonintubated state. *Stroke* 2010; 41:1180-1184.

9. Nichols C, Carrozzella J, Yeatts S,Tomsick T, Broderick J, Khatri P. Is periprocedural sedation during acute stroke therapy associated with poorer functional outcomes? *J NeuroIntervent Surg* 2010 ;2 :67-70.

10. Davis MJ, Menon BK, Baghirzada LB, Campos-Herrera CR, Goyal M, Hill MD et al; Calgary Stroke Program. Anesthetic management and outcome in patients during endovascular therapy for acute stroke. *Anesthesiology* 2012;116:396-405.

11. Abou-Chebl A, Zaidat OO, Castonguay AC, Gupta R, Sun CH, Martin CO et al. North American SOLITAIRE Stent-Retriever Acute Stroke Registry: choice of anesthesia and outcomes. *Stroke*. 2014;45:1396-401.

12. Soize S, Kadziolka K, Estrade L et al. Mechanical thrombectomy in acute stroke: prospective pilot trial of the Solitaire FR™ device while under conscious sedation. *AJNR Am J Neuroradiol* 2013;34:360-5.

13. Broderick JP, Palesch YY, Demchuk AM, for the Interventional Management of Stroke (IMS) III Investigators. Endovascular Therapy after Intravenous t-PA versus t-PA Alone for Stroke. *N Engl J Med* 2013;368:893 -903.

14. Ciccone A, Valvassori L, Nichelatti M, for the SYNTHESIS Expansion Investigators. Endovascular Treatment for Acute Ischemic Stroke. *N Engl J Med* 2013;368:904-913.

15. Soize S, Barbe C, Kadziolka K et al. Predictive factors of outcome and haemmorrhage after acute ischemic stroke treated by mechanical thrombectomy with a stent-retriever. *Neuroradiology* 2013;55:977-987.

16. Adams HP Jr, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL et al. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. *Stroke*. 1993;24:35-41.

17. Higashida RT, Furlan AJ, Roberts H, Tomsick T, Connors B, Barr J et al; ECASS Investigators. Trial design and reporting standards for intra-arterial cerebral thrombolysis for acute ischemic stroke. *Stroke*. 2003;34:e109-37.

18. Barber PA, Hill MD, Eliasziw M, Demchuk AM, Pexman JH, Hudon ME et al; ASPECTS Study Group. Imaging of the brain in acute ischaemic stroke: comparison of computed tomography and magnetic resonance diffusion-weighted imaging. *J Neurol Neurosurg Psychiatry*. 2005;76:1528-33.

19. de Margerie-Mellon C, Turc G, Tisserand M, Naggara O, Calvet D, Legrand L et al. Can DWI-ASPECTS substitute for lesion volume in acute stroke? *Stroke*. 2013;44:3565-7

20. Tei H, Uchiyama S, Usui T et al. Posterior circulation ASPECTS on diffusion-weighted MRI can be a powerful marker for predicting functional outcome. *J. Neurol* 2010;257:767-773.

21. Kapeller P, Barber R, Vermeulen RJ, Adèr H, Scheltens P, Freidl W et al.; European Task Force of Age Related White Matter Changes. Visual rating of age-related white matter changes on magnetic resonance imaging: scale comparison, interrater agreement, and correlations with quantitative measurements. *Stroke*. 2003;34:441-5.

22. Fiorelli M, Bastianello S, von Kummer R, del Zoppo GJ, Larrue V, Lesaffre E et al. Hemorrhagic transformation within 36 hours of a cerebral infarct: relationships with early clinical deterioration and 3-month outcome in the European Cooperative Acute Stroke Study I (ECASS I) cohort. *Stroke*. 1999;30:2280-4.

23. Behme D, Gondecki L, Fiethen S, Kowoll A, Mpotsaris A, Weber W. Complications of mechanical thrombectomy for acute ischemic stroke-a retrospective single-center study of 176 consecutive cases. *Neuroradiology* 2014, doi: 10.1007/s00234-014-1352-0

24. Akins PT, Amar AP, Pakbaz RS, Fields JD; SWIFT Investigators. Complications of endovascular treatment for acute stroke in the SWIFT trial with solitaire and Merci devices. *AJNR Am J Neuroradiol*. 2014;35:524-8

Tables

Table 1 - Characteristics of the 92 patients treated under conscious sedation

Patients characteristics	
Age, years	62.0 ± 16.1
Female, n (%)	42 (44.6 %)
Smoking	24 (26.1 %)
Hypertension	27 (29.3 %)
Diabetes mellitus	9 (9.8 %)
Dyslipidemia	25 (27.2 %)
Cardiovascular events	21 (22.8 %)
Cancer	6 (56.5 %)
Atrial fibrillation	10 (10.9 %)
Admission	
Dominant hemisphere	**42/86 (48.8 %)**
Baseline NIHSS	17.0 ± 5.2
Atrial fibrillation on ECG	23 (25.0 %)
Glycaemia, mmol/L	7.3 ± 2.5
Intravenous fibrinolysis	60 (64.5 %)
Occlusion location	
MCA	64 (69.6 %)
ICA	6 (6.5 %)
Tandem	16 (17.4 %)
Posterior circulation	6 (6.5 %)
Stroke aetiology	
Large-artery atherosclerosis	12 (12.6 %)
Cardio-embolic	39 (41.1 %)
Uncommon etiology	8 (8.4 %)
Undetermined	36 (37.9 %)

Table 2 - Baseline imaging results

Magnetic resonance imaging	88/92 (95.7 %)
Baseline ASPECTS	6.6 ± 2.0
Severe leukoaraiosis	19/92 (20.7 %)
Previous stroke	11/92 (12.0 %)
Intravascular FLAIR hyperintensities	73/82 (89.0 %)
Stroke FLAIR positivity	30/87 (34.5 %)
Susceptibility vessel sign (SVS)	59/80 (73.7 %)

Table 3 - Comparison between agitated and non-agitated patients: influence of baseline, procedural and post-procedural variables

	Agitated patients	**Non-agitated patients**	**P value**
Number	17 (18.5 %)	75 (81.5 %)	
Baseline			
Age, years	60.9 ± 17.0	62.3 ± 16.0	0.74
Female, n (%)	5 (29.4 %)	36 (48.0 %)	0.18
Atrial fibrillation on admission	4 (23.5 %)	19 (25.3 %)	1.00
Intravenous fibrinolysis	11 (64.7 %)	49 (65.3 %)	1.00
Baseline NIHSS	18.5 ± 5.1	16.6 ± 5.2	0.17
Baseline blood glucose level	8.3 ± 4.2	7.0 ± 1.8	0.04
Baseline ASPECTS	5.3 ± 2.2	6.9 ± 1.8	0.002
Dominant hemisphere stroke	**10 (58.8 %)**	**32 (42.7 %)**	**0.23**
Leukoaraiosis	5 (29.4 %)	14 (18.7 %)	0.33
Tandem occlusion	8 (47.1 %)	9 (12.0 %)	0.002
Procedure			
Angiography duration	54.2 ± 31.1	44.1 ± 26.3	0.17
Device deployments	1.7 ± 0.8	1.7 ± 1.1	1.00
Haemodynamic instability	3 (17.6 %)	5 (6.7 %)	0.16
Outcomes			
Technical feasibility	11 (64.7 %)	82 (96.5 %)	0.0005
Recanalisation TICI ≥2a	7 (41.2 %)	49 (65.3 %)	0.09
Recanalisation TICI ≥2b	6 (35.3 %)	40 (53.3 %)	0.28
Good neurological outcome (mRS ≥2)	5 (29.4 %)	39 (52.0 %)	0.11
Mortality	6 (35.3 %)	13 (17.3 %)	0.10
Intracranial haemmorrhage at day 1	5 (29.4 %)	9 (12.0 %)	0.12
Symptomatic ICH at day 1	3 (17.6 %)	4 (5.3 %)	0.11