Outcomes of basilar artery occlusion in patients aged 75 years or older in the Basilar Artery International Cooperation Study

Mervyn D. I. Vergouwen · Annette Compter · David Tanne · Stefan T. Engelter · Heinrich Audebert · Vincent Thijs · Gabriel de Freitas · Ale Algra · L. Jaap Kappelle · Wouter J. Schonewille

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Abstract Patients with an acute basilar artery occlusion (BAO) have a high risk of long-lasting disability and death. Only limited data are available on functional outcome in elderly patients with BAO. Using data from the Basilar Artery International Cooperation Study, we aimed to determine outcomes in patients ≥75 years. Primary outcome measure was poor functional outcome (modified Rankin scale score 4–6). Secondary outcomes were death, insufficient vessel recanalization (defined as thrombolysis in myocardial infarction score 0–1) and symptomatic intracranial hemorrhage (SICH). Patients were divided into four age-groups, based on quartiles: 18–54, 55–64, 65–74, and ≥75 years. Outcomes were compared between patients ≥75 years and patients aged 18–54 years. Risk ratios with corresponding 95 % confidence intervals (CI) were calculated and Poisson regression analyses were performed to calculate adjusted risk ratios (aRR). We included 619 patients [18–54 years n = 153 (25 %), 55–64 years n = 133 (21 %), 65–74 years n = 171 (28 %), and ≥75 years n = 162 (26 %)]. Compared with patients aged 18–54 years, patients ≥75 years were at increased risk of poor functional outcome [aRR 1.33 (1.14–1.55)] and death [aRR 2.47 (1.75–3.51)]. Nevertheless, 35/162 (22 %, 95 % CI 15–28 %) of patients ≥75 years had good functional outcome. No significant differences between age groups were observed for recanalization rate and incidence of SICH. Although patients ≥75 years with BAO have an increased risk of poor outcome compared with younger patients, a substantial group of patients ≥75 years survives with a good functional outcome.

On behalf of the BASICS Study Group.

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M. D. I. Vergouwen · A. Compter · A. Algra · L. Jaap Kappelle · W. J. Schonewille
Department of Neurology and Neurosurgery, UMC Utrecht Stroke Center, Rudolf Magnus Institute of Neurosciences, University Medical Center Utrecht, Heidelbergraan 100, 3584 CX Utrecht, The Netherlands
e-mail: M.D.I.Vergouwen@umcutrecht.nl

D. Tanne
Department of Neurology, Stroke Center, Chaim Sheba Medical Centre, Tel Aviv University, Tel-Hashomer, Israel

S. T. Engelter
Department of Neurology, University Hospital Basel, Basel, Switzerland

H. Audebert
Center for Stroke Research, Charité University Medicine Berlin, Campus Benjamin, Franklin, Germany

V. Thijs
Department of Neurology, University Hospitals Leuven and Vesalius Research Centre, VIB, Leuven, Belgium

G. de Freitas
Department of Neurology, University of Rio de Janeiro, Rio de Janeiro, Brazil

A. Algra
Julius Center for Health Sciences and Primary Care, University Medical Center, Utrecht, The Netherlands

W. J. Schonewille
Department of Neurology, St. Antonius Hospital, Nieuwegein, The Netherlands

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Introduction

Patients with an acute basilar artery occlusion (BAO) have a high risk of long-lasting disability and death [1, 2]. Although higher age, analyzed as a continuous variable, has been associated with poor functional outcome after BAO, only limited data are available on functional outcome in elderly patients [3–8]. One small case series of patients with BAO, only limited data are available on functional outcomes changed if poor functional outcome was defined as an mRS of 3–6. SICH was not predefined by the registry, and the reporting of SICH was done on the basis of each investigator’s judgment. For the purpose of this study, patients were divided into four age-groups, based on quartiles: 18–54, 55–64, 65–74, and ≥75 years. Outcomes were compared between patients ≥75 years and patients aged 18–54 years. Risk ratios (RR) and corresponding 95 % confidence intervals (CI) were calculated. Variables that affected the crude risk ratio most were used simultaneously in Poisson regression analyses to calculate adjusted risk ratios (aRR) [2]. Missing baseline data (<5 % for each variable) were imputed with regression imputation [10]. Finally, we explored the incidence of poor functional outcome in patients 75–79, 80–84, 85–89, and 90 years or older.

Results

Baseline characteristics are listed in Table 1. In total, 162 patients (26 % of total cohort) were ≥75 years. In this group of patients, the most common cause of stroke was embolism and 64 % had an NIHSS score ≥20. Treatment of any kind was initiated in 148 patients (91 %).

Modified Rankin Scale scores for all age groups are presented in Fig. 1. Patients ≥75 years had a higher risk of poor functional outcome [aRR 1.33 (1.14–1.55), Table 2] and death [aRR 2.47 (1.75–3.51), Table 3] than patients aged 18–54 years. Nevertheless, 35 patients (22 %, 95 % CI 15–28 %) of those ≥75 years had a good functional outcome. No significant differences between age groups were observed for insufficient recanalization [patients ≥75 vs. 18–54 years aRR 1.69 (0.95–3.03)] and SICH [patients ≥75 vs. 18–54 years RR 1.77 (0.77–4.06)]. Since SICH occurred in only 42 (7 %) patients, no further analyses were performed for this outcome measure.

If poor functional outcome was defined as an mRS of 3–6, the proportion of patients with poor functional outcome in each age group was 108/153 (71 %) in patients 18–54 years of age, 101/133 (76 %) in patients 55–64 years, 142/171 (83 %) in patients 65–74 years, and 137/162 (85 %) in patients ≥75 years. Also when this definition was used, patients ≥75 years had a higher risk of poor functional outcome [aRR 1.21 (1.07–1.36)] than patients aged 18–54 years.

Baseline characteristics of patients ≥75 years and their relationship with functional outcome are shown in Table 4. The following variables were associated with an increased risk of poor functional outcome after 1 month: male sex (RR 1.18, 95 % CI 1.00–1.38), location of occlusion (middle third vs. distal third: RR 1.21, 95 % CI 1.02–1.44), NIHSS score ≥20 on presentation (RR 1.36, 95 % CI 1.10–1.67), type of treatment (no treatment vs. intra-arterial thrombolytic therapy (IAT) only: RR 1.32, 95 % CI 1.15–1.52), SICH (RR 1.21, 95 % CI 1.03–1.43), and insufficient recanalization (RR 1.38, 95 % CI 1.07–1.77).
The proportion of patients with poor functional outcome in age subgroups ≥75 years was as follows: 64/82 (78%) in patients 75–79 years of age, 40/49 (82%) in patients 80–84 years, 16/23 (70%) in patients 85–89 years, and 7/8 (88%) in patients 90 years or older. The oldest patient with good functional outcome was 91 years of age, despite Table 1

| Variable                         | All patients | 18–54 years | 55–64 years | 65–74 years | ≥75 years |
|----------------------------------|--------------|-------------|-------------|-------------|-----------|
|                                  | n = 619      | n = 153     | n = 133     | n = 171     | n = 162   |
| Male sex                         | 390 (63%)    | 94 (61%)    | 105 (79%)   | 116 (68%)   | 75 (46%)  |
| Hypertension                     | 383 (62%)    | 41 (27%)    | 87 (65%)    | 133 (78%)   | 122 (75%) |
| Diabetes mellitus                | 135 (22%)    | 13 (8%)     | 31 (23%)    | 49 (29%)    | 42 (26%)  |
| Hyperlipidemia                   | 167 (27%)    | 30 (20%)    | 45 (34%)    | 55 (32%)    | 37 (23%)  |
| Atrial fibrillation              | 133 (21%)    | 3 (2%)      | 20 (15%)    | 42 (25%)    | 68 (42%)  |
| Coronary artery disease          | 109 (18%)    | 12 (8%)     | 21 (16%)    | 35 (20%)    | 41 (25%)  |
| Location of basilar artery occlusion |               |             |             |             |           |
| Distal third                     | 202 (33%)    | 42 (27%)    | 30 (23%)    | 55 (32%)    | 75 (46%)  |
| Middle third                     | 143 (23%)    | 37 (24%)    | 29 (22%)    | 46 (27%)    | 31 (19%)  |
| Proximal third                   | 274 (44%)    | 74 (48%)    | 74 (56%)    | 70 (41%)    | 56 (35%)  |
| Median NIHSS score (IQR)         | 22 (12–30)   | 20 (9–30)   | 20 (12–30)  | 22 (13–28)  | 25 (16–30)|
| NIHSS score >20                  | 336 (54%)    | 73 (48%)    | 66 (50%)    | 93 (54%)    | 104 (64%) |
| Type of treatment                |              |             |             |             |           |
| Antithrombotics                  | 183 (30%)    | 47 (31%)    | 33 (25%)    | 52 (30%)    | 51 (31%)  |
| IV tPA or IV tPA/IAT             | 121 (20%)    | 25 (16%)    | 37 (28%)    | 24 (14%)    | 35 (22%)  |
| IAT only                         | 288 (47%)    | 78 (51%)    | 59 (44%)    | 89 (52%)    | 62 (38%)  |
| No treatment                     | 27 (4%)      | 3 (2%)      | 4 (3%)      | 6 (4%)      | 14 (9%)   |
| Time to treatment                |              |             |             |             |           |
| 0–3 h                            | 179 (29%)    | 41 (27%)    | 39 (29%)    | 49 (29%)    | 50 (31%)  |
| 4–6 h                            | 190 (31%)    | 45 (29%)    | 37 (28%)    | 58 (34%)    | 50 (31%)  |
| 7–9 h                            | 84 (14%)     | 22 (14%)    | 19 (14%)    | 26 (15%)    | 17 (10%)  |
| 10–12 h                          | 57 (9%)      | 14 (9%)     | 14 (11%)    | 16 (9%)     | 13 (8%)   |
| 13–24 h                          | 55 (9%)      | 17 (11%)    | 15 (11%)    | 9 (5%)      | 14 (9%)   |
| >24 h                            | 27 (4%)      | 11 (7%)     | 5 (4%)      | 7 (4%)      | 4 (2%)    |
| Cause of stroke                  |              |             |             |             |           |
| Embolism                         | 224 (36%)    | 42 (27%)    | 38 (29%)    | 59 (35%)    | 85 (52%)  |
| Atherosclerosis                  | 215 (35%)    | 39 (25%)    | 57 (43%)    | 72 (42%)    | 47 (29%)  |
| Dissection                       | 32 (5%)      | 24 (16%)    | 5 (4%)      | 3 (2%)      | 0 (0%)   |
| Other                            | 6 (1%)       | 2 (1%)      | 1 (1%)      | 2 (1%)      | 1 (1%)   |
| Unknown                          | 142 (23%)    | 44 (29%)    | 30 (23%)    | 31 (18%)    | 27 (17%)  |

NIHSS national institutes of health stroke scale, IQR interquartile range, IV intravenous, tPA tissue plasminogen activator, IAT any intra-arterial treatment (either intra-arterial tPA, mechanical clot disruption, or both)

Fig. 1 Modified Rankin scale scores according to age group. mRS modified Rankin scale score

The proportion of patients with poor functional outcome in age subgroups ≥75 years was as follows: 64/82 (78%) in patients 75–79 years of age, 40/49 (82%) in patients 80–84 years, 16/23 (70%) in patients 85–89 years, and 7/8 (88%) in patients 90 years or older. The oldest patient with good functional outcome was 91 years of age, despite
an NIHSS score of 21 on admission. This patient was treated with intravenous recombinant tissue plaminogen activator (rtPA) only, and had an mRS score of 2 at 1 month follow-up.

Discussion

The BASICS study shows that patients ≥75 years with BAO have an increased risk of poor functional outcome and death compared with younger patients, despite comparable recanalization rates. In contrast with a small previous study [6], our data show that a substantial group of patients ≥75 years survives with good functional outcome. Previously, it has been suggested that the increased risk of poor functional outcome in elderly patients resulted from a higher prevalence of atherosclerotic occlusions and consequently lower recanalization rates [3]. However, in our study population patients ≥75 years were more likely to have an embolic rather than an atherosclerotic cause of BAO, mainly due to a higher prevalence of atrial fibrillation. Patients ≥75 years with an embolic cause of BAO had a similar risk of poor functional outcome compared with patients in this age group with an atherosclerotic cause of BAO. Sufficient recanalization was achieved in 71% of patients in this age group.

In patients ≥75 years, several baseline- and treatment-related characteristics were associated with an increased risk of poor functional outcome. A recent large case series of patients with BAO, in which only a minority of patients was ≥75 years, identified similar risk factors for poor functional outcome and death [7].

Table 2 Poor functional outcome (mRS 4–6) according to age-group

| Age-group | 18–54 years | 55–64 years | 65–74 years | ≥75 years |
|-----------|-------------|-------------|-------------|-----------|
| Total     | 153 (25%)   | 133 (21%)   | 171 (28%)   | 162 (26%) |
| Poor outcome | 91/153 (60%) | 85/133 (64%) | 126/171 (74%) | 127/162 (78%) |
| Unadjusted | 1.08 (0.90–1.29) | 1.24 (1.06–1.45) | 1.32 (1.13–1.54) |
| Adjusted  | 1.06 (0.88–1.28) | 1.23 (1.05–1.45) | 1.33 (1.14–1.55) |
| Male sex  | 1.06 (0.89–1.27) | 1.26 (1.08–1.47) | 1.37 (1.18–1.60) |
| Location of occlusion | 1.06 (0.90–1.25) | 1.22 (1.06–1.41) | 1.23 (1.06–1.41) |
| NIHSS     | 1.08 (0.90–1.30) | 1.26 (1.07–1.49) | 1.35 (1.13–1.56) |
| Time to treatment (h) | 1.07 (0.89–1.29) | 1.24 (1.05–1.46) | 1.32 (1.12–1.55) |
| Type of treatment | 1.05 (0.89–1.24) | 1.24 (1.07–1.43) | 1.28 (1.11–1.48) |
| 3 factors | 1.06 (0.90–1.25) | 1.28 (1.10–1.49) | 1.33 (1.14–1.55) |
| 5 factors | 1.06 (0.90–1.25) | 1.28 (1.10–1.49) | 1.33 (1.14–1.55) |

Table 3 Mortality according to age group

| Age-group | 18–54 years | 55–64 years | 65–74 years | ≥75 years |
|-----------|-------------|-------------|-------------|-----------|
| Total     | 153 (25%)   | 133 (21%)   | 171 (28%)   | 162 (26%) |
| Mortality | 33/153 (22%) | 43/133 (32%) | 80/171 (47%) | 84/162 (52%) |
| Unadjusted | 1.50 (1.02–2.21) | 2.17 (1.54–3.05) | 2.40 (1.72–3.37) |
| Adjusted  | 1.48 (1.02–2.19) | 2.16 (1.53–3.04) | 2.43 (1.73–3.40) |
| Male sex  | 1.47 (0.99–2.16) | 2.22 (1.58–3.11) | 2.55 (1.83–3.56) |
| Location of occlusion | 1.46 (1.00–2.12) | 2.13 (1.55–2.94) | 2.16 (1.57–2.98) |
| NIHSS     | 1.56 (1.04–2.35) | 2.28 (1.59–3.27) | 2.41 (1.68–3.46) |
| Time to treatment (h) | 1.55 (1.03–2.34) | 2.24 (1.56–3.21) | 2.42 (1.68–3.47) |
| Type of treatment | 1.47 (1.02–2.12) | 2.22 (1.61–3.05) | 2.31 (1.68–3.17) |
| 3 factors | 1.56 (1.05–2.31) | 2.41 (1.71–3.39) | 2.47 (1.75–3.51) |
| 5 factors | 1.56 (1.05–2.31) | 2.41 (1.71–3.39) | 2.47 (1.75–3.51) |

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The strength of this study is that BASICS was a prospective registry of consecutive patients, and therefore our results are representative for daily practice. A limitation of this study is that this was a post hoc analysis of non-randomized data, and therefore the data regarding treatment-dependent outcomes are prone to bias. Due to the prospective collection of detailed data, we were able to perform Poisson regression analyses to adjust for important confounding baseline characteristics.

We conclude that a substantial group of elderly patients survives with a good functional outcome. This study cannot answer the question which treatment option is superior in elderly patients, nor can it define an upper age limit above which treatment is no longer effective. These and other questions may be answered in the recently started BASICS trial in which patients with BAO of up to 85 years of age are randomized between intravenous thrombolysis (IVT) alone vs. IVT followed by additional intra-arterial therapy (http://www.trialregister.nl/trialreg/admin/rctview.asp?TC=2617; accessed February 1, 2012).

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Conflicts of interest All authors report no disclosures.

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