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Outcomes from ischemic stroke subtypes classified by the Oxfordshire Community Stroke Project: a systematic review

M. PACI, L. NANNETTI, P. D'IPPOLITO, B. LOMBARDI

Department of Rehabilitation Medicine
Prato Hospital, Prato, Italy

Background. **Stroke is a highly heterogeneous disorder with distinct subtypes, each presenting specific clinical aspects. Information on prognosis of ischemic stroke subtypes help to improve clinical management and rehabilitation treatments.**
Aim. **Summarize findings of studies on outcome in stroke subtypes categorized by use of the Oxfordshire Community Stroke Project (OCSP) classification.**
Design. **Systematic review.**
Setting. **Not applicable.**
Population. **Adult post-stroke patients.**
Methods. **Systematic literature research of five databases was undertaken to identify relevant studies. Outcomes were examined in terms of impairment, activity restriction and participation restriction. Quality of Life and mortality was also examined for each study.**
Results. **Sixteen studies met inclusion criteria. Most studies measure outcome in terms of activity limitations and participation restriction. Only one study measures impairment. TACI group have poor outcomes in comparison with other groups. Outcomes of LACI, PACI and POCI groups are controversial.**
Conclusion. **Stroke subtype is a factor influencing outcome. However, differences among groups, overall in terms of impairment, should be further investigated.**
Clinical rehabilitation impact. **Different prognosis of stroke subtypes may imply different rehabilitation managements.**

KEY WORDS: Cerebrovascular disorders - Cerebral infarction - Stroke - Ischemia - Outcome assessment (health care).

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Corresponding author: B. Lombardi, MD, c/o Casa di Cura Villa Fiorita, Via di Cantagallo, 49, 59100 Prato, Direttore U.O.C. Medicina Fisica e Riabilitativa, Azienda USL 4, Prato.
E-mail: blombardi@usl4.toscana.it

Stroke is a highly heterogeneous disorder with distinct subtypes, each presenting specific clinical aspects. Subtypes characterization of stroke may improve knowledge of different outcomes. A number of classifications of stroke subtypes are available, namely, for example, Lausanne Stroke Registry [1, 2] and TOAST.[3]

In 1991 Bamford *et al*.[4] proposed a simple method of categorizing acute ischemic stroke patients based on a population study of first ever stroke in the Oxfordshire Community Stroke Project (OCSP). This classification includes lacunar (LACI), posterior (POCI), total anterior (TACI) and partial anterior (PACI) circulation infarcts.

The OCSP classification is a simple and rapid method of classification for acute ischemic stroke patients. It has good interobserver reliability, predicts site and size of infarct on computed tomography (CT), predicts case fatality and functional recovery, and is easy to apply without specialist neurologic training.[5-8]

During recent years, a number of articles have been published which add knowledge on outcomes in different stroke subtypes. The aim of this review is to summarize findings of studies on outcome in stroke subtypes categorized by use of the

TABLE I.—*Distribution of stroke subtypes in selected studies.*

Author, year	PACI	TACI	POCI	LACI	Total IS	ICH	Total
Bamford [4] 1991	185 (34.0%)	92 (17.0%)	129 (24.0%)	137 (25%)	543		
Smith [10] 1997	81 (40.3%)	44 (21.9%)	15 (7.5%)	61 (30.3%)	201	28 (12.2%)	
Pinto [11] 1998	55 (25.8%)	29 (13.6%)	66 (30.9%)	63 (29.6%)	213	84 (28.3%)	297
Tei [12] 2000	63 (18.0%)	86 (24.6%)	60 (17.1%)	141 (40.3%)	350		
Baer [13] 2001	74 (39.8%)	27 (14.6%)	36 (19.5%)	48 (26.0%)	185		
Lawrence [14] 2001	250 (28.9%)	189 (21.9%)	142 (16.4%)	283 (32.8%)	864	247 (19.6%)	1259 (148 unclassified)
Sturm [15] 2002	43 (42.6%)	10 (9.9%)	21 (20.8%)	27 (26.7%)	101	8 (7.0%)	113
Pittock [16] 2003	24 (21.0%)	31 (26.0%)	14 (12.0%)	48 (41.0%)	117		
Dewey [17] 2003	72 (36.0%)	34 (17.0%)	45 (22.5%)	49 (24.5%)	200	52 (18.8%)	276
Sturm [18] 2004	78 (40.4%)	19 (9.8%)	45 (23.3%)	51 (26.4%)	193	27 (11.9%)	226
Sturm [19] 2004a	111 (34.5%)	76 (23.6%)	67 (20.8%)	68 (21.1%)	322		
Nedeltchev [20] 2005	77 (38.9%)	29 (14.6%)	58 (29.3%)	34 (17.2%)	198		
Di Carlo [21] 2006	740 (29.9%)	659 (26.7%)	413 (16.7%)	660 (26.7%)	2472		
Cheung [22] 2007	188 (33.2%)	21 (3.7%)	38 (6.7%)	319 (56.4%)	566	189 (25.0%)	755
Sprigg [23] 2007	473 (31.9%)	523 (35.2%)	66 (4.5%)	422 (28.4%)	1484		
Turhan [24] 2009	32 (24.8%)	48 (37.2%)	17 (13.2%)	32 (24.8%)	129		

*Number of patients assessed at follow up. LACI: lacunar infarcts; POCI: posterior infarcts; TACI: total anterior infarcts; PACI: partial anterior infarcts; IS: ischemic stroke; ICH: intracerebral hemorrhage.

Oxfordshire Community Stroke Project (OCSP) classification.

Materials and methods

Search strategy

We systematically and electronically searched the literature from 1991 up to November 2009 to identify relevant trials for this review.

We searched the PEDro, MEDLINE®, DARE, Cochrane Library and EMBASE® databases using combinations of the key words: "stroke", "cerebral infarct", "Bamford", "acute ischemic stroke", "cerebral infarction", "stroke classification", "ischemic stroke classification", "stroke outcome", "cerebrovascular disorders", "outcome" and "outcome assessment".

In addition, we manually searched reference lists and bibliographies of related journal articles and books for additional trials.

We considered all studies in English and Italian that concerned outcome from stroke subtypes in terms of impairment, disability or handicap.

Articles selection was based on the title and the abstract. Data extraction was based on the entire text of each selected article.

Studies in English and Italian that use the Oxfordshire Community Stroke Project (OCSP) classification were included.

Other inclusion criteria were first ever stroke and adults (more than 18 years of age) as study population and functional status as primary outcome measures. Studies including less than all four subgroups were excluded.

Statistical analysis

Outcomes were examined in terms of the three health domains described by the International Classification of Functioning and Disability (ICF):[9] impairment, activity restriction and participation restriction. Consistent with the ICF guidelines, we also considered measures of Quality of Life (QoL). Moreover, mortality was examined for each study as secondary measures.

Results

The search resulted in 163 potentially relevant studies and, finally, sixteen studies were included in the review. The main reasons of the exclusion of 147 studies were: other then OCSP as stroke subtype classification, other than functional status as primary outcome measures, intervention studies, studies on risk factors for stroke subtypes and validation studies on stroke subtypes classification psychometric properties. Studies analyzed a total of 8773 patients, of whom

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TABLE II.—*Characteristics of the selected studies.*

Author, year	Outcomes	Outcome data collection
Bamford [4] 1991	Mortality Ranking Scale	1, 6 and 12 month
Smith [10] 1997	Milestones	NA
Pinto [11] 1998	Ranking Scale Length of hospital stay institutionalization	Discharge
Tei [12] 2000	Mortality Ranking Scale	24 hours
Baer [13] 2001	10 meter walking time	Admission and discharge
Lawrence [14] 2001	Barthel Index	1 and 3 months
Sturm [15] 2002	Barthel Index London handicap scale	3 and 12 months
Pittock [16] 2003	European stroke scale Barthel Index 10 meter walking time Rivermead motor assessment Oxford handicap scale Length of hospital stay	Admission, 2 weeks, and 6 months
Dewey [17] 2003	Barthel Index	3 and 12 months
Sturm [18] 2004	London handicap scale	2 years
Sturm [19] 2004a	London handicap scale Assessment of Quality of Life	2 years
Nedeltchev [20] 2005	Modified Ranking Scale	3 months
Di Carlo [21] 2006	Barthel Index Ranking Scale Institutionalization	3 months
Cheung [22] 2007	Ranking Scale Mortality	30 days, 1 year, and 5 years
Sprigg [23] 2007	Ranking Scale Barthel Index	At baseline and days 4, 7 and 10
Turhan [24] 2009	Functional Independence Measure	Admission and discharge

NA: not available.

8138 with ischemic stroke. Within patients with ischemic stroke, 2546 (31.3%) were classified as PACI, 1917 (23.6%) as TACI, 1232 (15.1%) as POCI, and 2443 as LACI (30.0%) (Table 1). Frequency for each subtype varied between 18% and 42.6% for PACI, 3.7% and 35.2% for TACI, 4.5% and 29.3% for POCI and 17.2% and 56.4% for LACI. Most studies measure outcome in terms of participation restriction (N=11) and activity limitations (N=8), and 1 study measure impairment.

Studies differ in terms of number of patients enrolled (ranging from 101 to 2472), assessment point and follow up end-point (ranging from 24-48 hours to 5 years) (Table II). Moreover, a number of studies [4, 15-19, 22] lack of information about frequency and type of rehabilitation treatments. In some cases, this information was impossible to provide because of the early assessment end-point.[12, 23]

Impairment

Only one study included measure of impairment as outcome,[16] using the European stroke scale, founding that TACI group have the poorest outcome.

Activity limitations

A number of studies (N=8) assess the activity limitations, generally using the Barthel Index (BI).[14-17, 21-23] Other outcome scales used for activity limitations evaluation are the Rivermead Motor Assessment,[16]

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the 10 meter walking time test [13, 16] and the Functional Independence Measure.[24]

Results in terms of activity limitations are not univocal. Many studies [14-17, 23-24] report TACI group having the worst outcome and no differences between the other groups.

However, according to Di Carlo,[21] both PACI and TACI groups were more disabled at 3 months, when compared to the others.

Participation restriction

Eleven studies measure participation restriction.[4, 11, 12, 15, 16, 18, 19, 20-23] The most frequently used outcome tool was the Ranking Scale (or its modified version).[4, 11, 12, 20-23] Other outcome scale used were the Oxford Handicap Scale,[16] London Handicap Scale [15, 18, 19] and Length of hospital stay.[11, 16] According to almost all studies, TACI group had significantly worse outcome, when compared to the other groups. According to Pinto *et al*.,[11] patients with TACI syndrome had also less probability to discharge to previous home. However, Di Carlo *et al*.[21] report that both PACI and TACI groups were more likely to be discharged to an institution and more severely handicapped at 3 months. Sprigg *et al*.[23] found also that, although patients of TACI group have the worst performance at all assessment points, they may anyhow have a clinically significant improvement in outcome.

Other outcome measures

Quality of life

One study [19] assesses health-related quality of life (QoL) using the Assessment of Quality of Life (AQoL). Reported results indicate that TACI subtype is significantly associated with worse health-related QoL.

Mortality

Three of selected studies report data on mortality [4, 12, 22] and all they describe that TACI group had significantly higher mortality.

Discussion

Reported prevalence of stroke subtypes shows high inter-trials variability. Probably these results are due to differences in terms of sample sizes, settings and follow-up. The use of assessment tools is also different between studies. In particular, impairment is the less used assessment domain.

Impairment and disability are probably important determinants of handicap. However, we choice to examine results in terms of the three health domains described by the ICF because impairment is not able to explain fully activity limitations [14, 25] and participation restriction is only partly explained by disability.[15] In fact, factors such as comorbidity, motivation, depression, or social support are frequently influencing these domains.[26]

This review shows that TACI group has poor outcomes in comparison with other groups. However, Sprigg *et al*.[23] found that patients with a TACI syndrome may achieve a reasonable outcome if early recovery occurs. This issue should be necessary to determine the appropriate nursing and rehabilitation needs of patients with TACI subtype.

Outcome results of LACI, PACI and POCI groups are controversial. Probably it may be due to the heterogeneity of impairments that may be present in each subgroup. For example, patients of LACI group may show pure motor stroke or hemiparesis, ataxic hemiparesis, dysarthria/clumsy hand, pure sensory stroke or mixed sensorimotor stroke.[4] These different symptoms may involve in high variable motor or functional outcomes. Moreover, Smith *et al*.,[10] in a study assessing with BI and Motricity Index the recovery patterns of patients with TACI and POCI syndromes, report wide variations in individual recovery relative to the mean values.

Stroke subtype seems to be a factor influencing outcome. However, most studies measure outcome in terms of activity limitations and participation restriction. Differences among groups, overall in terms of impairment, should be further investigated.

Many studies lack to describe information such as the time from stroke at the baseline assessment and the length of stay in hospital. Moreover, only one study reports duration, intensity and characteristics of rehabilitation.[24] These variables might explain part of results. In fact, generally, patients with a very poor functional state (such as total anterior circulation infarction), as well as patients with a mild stroke (such as some lacunar infarction), are not admitted for inpatient rehabilitation. The admission or not admission in a rehabilitation process, and its characteristics, might have introduced some bias. Most studies have been conducted in departments for acute or sub-acute phases of stroke (i.e. neurology or medicine departments),[4,

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[11, 12, 14-16, 19, 20, 22, 23] and report the admission to a rehabilitation centre as an adverse outcome. On the contrary, a rehabilitation process should be implemented for a large group of patients in order to enhance motor and functional outcome.

Limitations of the study

Some trials could not be included in this review because some studies analyze classification of stroke subtypes as one of a number of dependent variables influencing outcomes, and it might be occurred that outcome in stroke subtypes was not clearly reported in title or abstract. Moreover, we only included publications in English and Italian and this choice may have introduced a publication bias.

References

1) Bogousslavsky J, Van Melle G, Regli F. The Lausanne Stroke Registry: analysis of 1,000 consecutive patients with first stroke. Stroke 1988;19:1083-92.
2) Bogousslavsky J, Regli F, Besson G, Melo TP, Nater B. Early Clinical Diagnosis of Stroke Subtype. Cerebrovasc Dis 1993;3:39-44.
3) Madden KP, Karanjia PN, Adams HP Jr, Clarke WR. Accuracy of initial stroke subtype diagnosis in the TOAST study. Trial of ORG 10172 in Acute Stroke Treatment. Neurology 1995;45:1975-9.
4) Bamford J, Sandercock P, Dennis M, Burn J, Warlow C. Classification and natural history of clinically identifiable subtypes of cerebral infarction. Lancet 1991;337:1521-6.
5) Anderson CS, Taylor BV, Hankey GJ, Stewart-Wynne EG, Jamrozik KD. Validation of a clinical classification for subtypes of acute cerebral infarction. J Neurol Neurosurg Psychiatry 1994;57:1173-9.
6) Lindley RI, Warlow CP, Wardlaw JM, Dennis MS, Slattery J, Sandercock PA. Interobserver reliability of a clinical classification of acute cerebral infarction. Stroke 1993;24:1801-4.
7) Mead GE, Lewis SC, Wardlaw JM, Dennis MS, Warlow CP. How well does the Oxfordshire Community Stroke Project classification predict the site and size of the infarct on brain imaging? J Neurol Neurosurg Psychiatry 2000;68:558-62.
8) Aerdean L, Luijckx GJ, Ricci S, Hilton A, Kessels F, Lodder J. Validation of the Oxfordshire Community Stroke Project syndrome diagnosis derived from a standard symptom list in acute stroke. J Neurol Sci 2004;220:55-8.
9) WHO. ICF - International Classification of Function, Disability and Health. Short Version. Geneva: World Health Organization, 2001.
10) Smith J, Brotheridge S, Young J. Patterns of hemiparesis recovery in lacunar and partial anterior circulation infarct stroke syndromes. Clin Rehabil 2001:15:59-66.
11) Pinto AN, Melo TP, Lourenço ME, Leandro MJ, Brázio A, Carvalho L *et al.* Can a clinical classification of stroke predict complications and treatments during hospitalization? Cerebrovasc Dis 1998;8: 204-9.
12) Tei H, Uchiyama S, Ohara K, Kobayashi M, Uchiyama Y, Fukuzawa M. Deteriorating ischemic stroke in 4 clinical categories classified by the Oxfordshire Community Stroke Project. Stroke 2000;31: 2049-54.
13) Baer G, Smith M. The recovery of walking ability and subclassification of stroke. Physiother Res Int 2001;6:135-44.
14) Lawrence ES, Coshall C, Dundas R, Stewart J, Rudd AG, Howard R, *et al.* Estimates of the Prevalence of Acute Stroke Impairments and Disability in a Multiethnic Population. Stroke 2001;32:1279-84.
15) Sturm JW, Dewey HM, Donnan GA, Macdonell RAL, McNeil JJ, Thrift AG. Handicap After Stroke: How Does It Relate to Disability, Perception of Recovery, and Stroke Subtype? Stroke 2002;33: 762-8.
16) Pittock SJ, Meldrum D, Hardiman O, Thornton J, Brennan P, Moroney JT. The Oxfordshire Community Stroke Project Classification: Correlation With Imaging, Associated Complications, and Prediction of Outcome in Acute Ischaemic Stroke. J Stroke Cerebrovasc Dis 2003;12:1-7.
17) Dewey H, Macdonell R, Donnan G, Freeman E, Thrift A, Sharples C. Inter-rater reliability of stroke sub-type classification by neurologists and nurses within a community-based stroke incidence study. J Clin Neurosci 2001;8:14-7.
18) Sturm JW, Donnan GA, Dewey HM, Macdonell RAL, Gilligan AK, Srikanth V *et al.* Quality of Life After Stroke: The North East Melbourne Stroke Incidence Study (NEMESIS). Stroke 2004;35: 2340-5.
19) Sturm JW, Donnan GA, Dewey HM, Macdonell RAL, Gilligan AK, Srikanth V *et al.* Determinants of Handicap After Stroke: The North East Melbourne Stroke Incidence Study (NEMESIS). Stroke 2004;35:715-20.
20) Nedeltchev K, der Maur TA, Georgiadis D, Arnold M, Caso V, Mattle HP *et al.* Ischaemic stroke in young adults: predictors of outcome and recurrence. J Neurol Neurosurg Psychiatry 2005;76: 191-5.
21) Di Carlo A, Lamassa M, Baldereschi M, Pracucci G, Consoli D, Wolfe CD *et al.* European BIOMED Study of Stroke Care Group. Risk factors and outcome of subtypes of ischemic stroke. Data from a multicenter multinational hospital-based registry. The European Community Stroke Project. J Neurol Sci 2006;244:143-50.
22) Cheung CM, Tsoi TH, Hon SFK, Au-Yeung M, Shiu KL, Lee CN *et al.* Outcomes after first-ever stroke. Hong Kong Med J 2007;13: 95-9.
23) Sprigg N, Gray LJ, Bath PM, Lindenstrøm E, Boysen G, De Deyn PP *et al.* TAIST Investigators. Stroke severity, early recovery and outcome are each related with clinical classification of stroke: data from the 'Tinzaparin in Acute Ischaemic Stroke Trial' (TAIST). J Neurol Sci 2007;254:54-9.
24) Turhan N, Atalay A, Muderrisoglu H. Predictors of functional outcome in first-ever ischemic stroke: A special interest to ischemic subtypes, comorbidity and age. NeuroRehabilitation. 2009;24: 321-6.
25) Nannetti L, Paci M, Pasquini J, Lombardi B, Taiti PG. Motor and functional recovery in patients with post-stroke depression. Disabil Rehabil. 2005;27:170-5.
26) Gilbertson L, Langhorne P, Walker A, Allen A, Murray GD. Domiciliary occupational therapy for patients with stroke discharged from hospital: Randomised controlled trial. BMJ 2000;320:603?06.

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