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Short Communication

Anger and stroke: a potential association that deserves serious consideration

Rosa PB, Orquiza B, Rocha FB, Donadel RW, Diniz RP, Beloni TMN, Aniceto JT, Fragoso YD. Anger and stroke: a potential association that deserves serious consideration.

Objective: To assess the relationship between states of anger and stroke.
Methods: Systematic review of the literature.
Results: In total, 21 papers were selected for the systematic review of data published on the subject of anger and stroke. A state of anger may be a risk factor for stroke, as well as a consequence of brain lesions affecting specific areas that are caused by a stroke. Scales to assess anger varied among authors. There was no consensus regarding the area of brain lesions that might lead to a state of anger. Although some authors agreed that lesions on the right side led to angrier behaviour, others found that lesions on the left side were more relevant to anger. Likewise, there was no consensus regarding the prevalence of anger pre or post-stroke. Some authors did not even find that these two conditions were related.
Conclusion: Although most authors have accepted that there is a relationship between anger and stroke, studies with uniform methodology need to be conducted if this association is to be properly evaluated and understood.

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Keywords: anger; brain lesion; cerebrovascular disease; emotions; stroke

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Significant outcomes

- A state of chronic anger may be associated with higher risk of stroke.
- Anger may also be a consequence of a stroke that led to brain lesions in specific areas.
- There is a paucity of studies on the association between anger and stroke.

Limitations

- The methodological assessment of anger varied among authors.
- There is no clear definition of 'anger' in some papers.
- The conclusions from different papers varied and therefore no uniform overall conclusion can be reached.
- There are few case-control studies assessing the potential relationship between stroke and anger.

Introduction

Anger is a strong feeling reflecting frustration, annoyance and belligerence towards people who are sources of real (or supposed) grievance and/or towards situations that seem to be uncontrollable. There are many words to define the degrees of anger, such as wrath, enragement, exasperation, irascibility and rage. When chronic, they all reflect a negative state of mind that goes beyond a natural emotional response that provides protection in dealing with unpleasant situations (1). The manifestations of anger are complex, and while some individuals mainly present

a state of 'anger-in' (tendency to suppress anger), others present 'anger-out' (tendency to express anger through verbal or physical means) (2).

An association between anger and cardiovascular disease has long been established. Patients with a psychological trait of chronic anger may be at increased risk of heart ischaemia and worse prognosis for its outcomes (3,4). There seems to be no higher prevalence of 'anger-in' or 'anger-out' traits of anger (as described above) among patients at risk of cardiovascular events (5). Although detailed and methodologically sound, papers describing the association between anger and myocardial infarction exist in the literature (6,7), there is a paucity of studies on a potential bidirectional association between anger and stroke (8,9). Stroke is a leading cause of mortality and morbidity in modern society (10), and it has trigger factors similar to those of coronary heart disease (11). The association between stroke and anger is more complex than the association between heart disease and anger, since the location of the brain lesion may be a determinant of behaviour (9). Thus, a patient who suffers a stroke and presents anger as a manifestation of the brain lesion may be at risk of further cardiovascular and cerebrovascular disease because of these sequelae. The present paper systematically reviews the potential association between anger and stroke.

Strategy for literature search

The present work followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (12). Using the population (patients with stroke), intervention (anger), comparison (control) and outcomes (stroke) framework (PICO) (13), the authors independently searched for the terms 'anger' AND 'stroke' OR 'cerebrovascular' in the following databases: Medline, PubMed, Scopus, Index Medicus, Biomed Central, LILACS, SciELO, Google Scholar and the Cochrane Database of Systematic Reviews. There was no limit on the starting date in the search that ended in December 2015. Abstracts of articles in any language containing these words in English (in the title, keywords or abstract) were independently reviewed by all authors individually, and then discussed among groups of two or three authors. The list of references of each paper considered to be pertinent to the systematic review was also carefully searched for other potential papers on the subject. Following this initial search, a meeting with all the authors was organised. This meeting was part of the strategy for the systematic review. All papers considered relevant to the review by at least one author were voted by all to decide whether it should really be included.

The outcomes were 'anger prior to stroke', 'anger in association with stroke onset' and 'anger post-stroke'. Only articles presenting original work with analysis of at least one of the previously mentioned outcomes among patients with stroke were included. Abstracts from scientific meetings, review papers, anecdotal case reports, validation of assessment tools, comments on other papers, duplicate articles and editorials were excluded. Every effort was made to obtain the full text of all relevant articles, thus resulting in a list of relevant studies fulfilling the data strategy. The present systematic review did not include meta-analyses on results. The studies assessed reported essentially on the prevalence of outcomes (anger associated with stroke) and not interventions.

Results

Figure 1 shows the summary from the article search and retrieval of relevant papers. After the initial

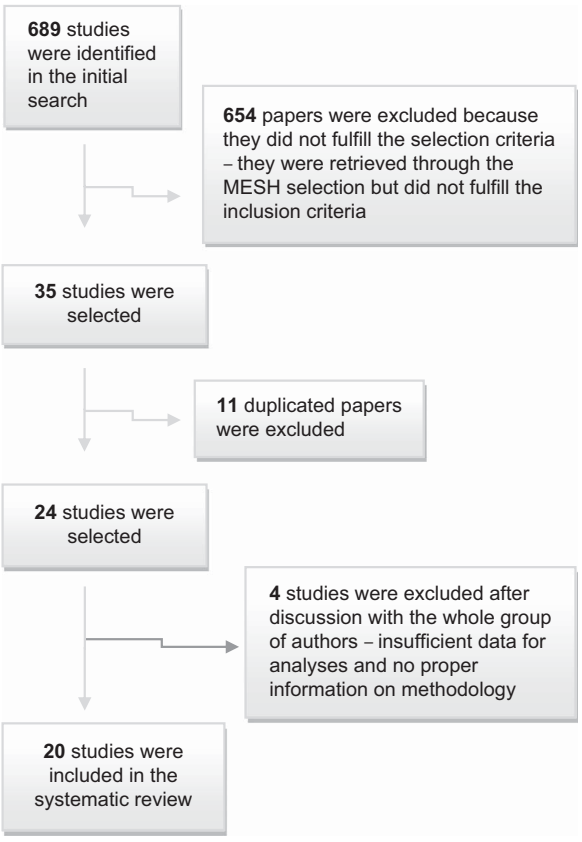

Fig. 1. Flow diagram of articles selected for the systematic review on the association between anger and stroke. In total, 654 papers were excluded through the initial assessment because their titles were misleading. Some of them dealt with stroke, and some with anger, but all of them had perspectives differing from the ones that we considered to be inclusion criteria. The further exclusion of four papers after group discussion was due to insufficient data for analyses or inadequate methodology.

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search and exclusion, 25 papers were taken for detailed analyses and discussion by the authors. These papers fulfilled the inclusion criteria. However, four of these papers were subsequently excluded because either they did not present sufficient information or because their methods of assessment were inadequate. The decision to exclude these papers was based on the excessive confounders they could introduce in the present review. In short, 21 papers were selected as fulfilling the selection criteria and were included in the systematic review (8,14–33). They all included adults aged 18 years and above.

Eight papers were from the United States (8,14, 15,17,21,22,27,29), three from South Korea (24,28,30) and two from Italy (25,33) and Switzerland (23,26), whereas other countries contributed with one paper each: Israel (20), Portugal (25), Japan (16), Canada (18), Taiwan (32) and India (19). Eight studies were observational (19,20,22,24–26,30,32); four were case-control studies (21,27,31,33); one was longitudinal over 4 days (23) and six were population-based epidemiological studies (8,14–18). Two studies were clinical trials for specific treatment of psychological disorders after the stroke (28,29).

The most frequently used tool for assessing anger was the 'Spielberger Anger Expression Scales', which were used in nine studies (14–17,24, 28–31). Other papers made use of the 'Onset Anger Scale' (19), 'Stroke Risk Calculator' (18), 'Emotional and Social Dysfunction Questionnaire' (32), 'Affective Neuroscience Personality Scale' (33), 'Attachment Style Questionnaire' (33), 'Catastrophic Reaction Scale' (25), 'Mania Rating Scale' (25), 'Emotional Behavior Index' (26), 'Comprehensive Psychopathologic Rating Scale' (25) and also scales that had been specifically designed for that particular study (8,20–23,27). All of the scales were used either separately or in association with each other in the different studies. Seven papers assessed anger as a potential causal risk factor for stroke (8,14–20) and 14 papers assessed anger post-stroke (21–33). A summary of the results from these 21 papers is presented in Table 1.

Discussion

The physiological response to stressful situations like anger includes haemodynamic and cardiac changes that seem to be able to lead to coronary heart disease or stroke. A sudden or sustained state of catecholamine secretion in the bloodstream (typical of anger reactions), may exert effects on the myocardium and the smooth muscle of blood vessels. Although the relationship between anger and ischaemic heart disease is well documented, the same is not observed in relation to stroke. The present systematic review showed that there are few studies correlating anger and stroke, and they use very different methodological approaches to this matter. Although anger is a potential risk factor for heart disease, it seems to be involved both as a cause and as a consequence of the cerebrovascular event in stroke cases. In analysing only 20 papers with different methodological approaches to these questions, the relationship between anger and stroke seemed to go both ways. The conflicting observations of this review were that anger traits were often reported as being remarkably associated with higher risk of stroke (8,14), or not (17,19). In fact, one study showed that moderate anger can be a protective factor against stroke (15), and others reported that the trait of anger is not a frequently felt feature observed after a stroke (23,32). These findings may reflect results from papers with various methodological approaches, with different populations of patients, and with a mixture of outcomes assessed by some studies but not by others. Brain lesions caused by stroke might be associated with anger if they occurred in the left brain hemisphere (22), or in the right (27,33). However, one paper reported that no correlation between anger and specific areas of brain lesions could be established (25). Although one paper correlated anger with lesions in the frontal-lenticulocapsular-pontine base areas (24), another correlated anger with haemorrhagic lesions (26).

Other relevant findings were that more prominent cognitive dysfunction was observed among patients with stroke and anger than among those with stroke, but without the trait of anger (21). The only papers on treatment showed that fluoxetine and behavioural techniques may be appropriate approaches for the emotional disturbances (including anger) that follow stroke (28,29).

A review on the prevalence of anger and other psychological disorders after stroke was published recently (9). That paper differs from the present one, since the authors of that review only used Medline as the search tool. Furthermore, only papers written in the English language were searched for, and the authors addressed the trait of anger after the stroke episode, but not as a risk factor. In addition, other psychological characteristics were also part of that review. Those authors concluded that anger can be a trait after stroke in 15–57.2% of patients, but standard tools to assess psychiatric outcomes after an ictus are of essence in future studies (9).

The present study highlighted the conflicting aspects of this potential association between anger and stroke. There are not many studies on this subject, and the results are not consistent. Confounders must be taken into consideration, since age, gender, geographical

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Table 1. Summary of data from papers selected in this systematic review

Pre-stroke				
Authors	Country and year	Number of patients	Study design	Main findings
Everson et al. (8)	USA, 1999	2 074	Population-based study with 8.3 months follow-up	Men with self-reported anger were at higher risk of stroke Man with anger traits and previous ischaemic heart attack had a six times higher chance of stroke
Williams et al. (14)	USA, 2002	13 851	Population-based study with 77.3 months follow-up	Anger trait was associated to increased risk of stroke only for patients aged 60 years of less, and for those who had higher values of high-density-lipoprotein-cholesterol
Eng et al. (15)	USA, 2003	23 522	Population-based study with 24 months follow-up	Moderate anger expression was associated to a lower risk of stroke (population of high socioeconomic status and low anger trait, on average)
Ohira (16)	Japan, 2010	6 292	Population-based study with 10 years follow-up	Anger suppression increased the risk of cardiovascular and cerebrovascular disease. Depression was better correlated with stroke than with anger. The excess risk was related to ischaemic stroke only
Everson-Rose et al. (17)	USA, 2014	6 749	Population-based study with 8.5 years follow-up	Depressive symptoms, chronic stress and hostility were associated to higher risk of stroke. The same was not observed for trait anger
Nobel et al. (18)	Canada, 2014	17 805 patients (358 strokes)	Population-based study with 11 years follow-up	Anger expression increased the risk of stroke in this long-term longitudinal population study
Sharma et al. (19)	India, 2015	290	Hospital-based study with patients who had a stroke	Stressful life events, alcohol abuse and infections were 2 to 3 times more likely to be associated to stroke than trait anger
Koton et al. (20)	Israel, 2004	200	Hospital-based case cross-over study with patients who had a stroke	Patients at the acute phase of stroke (up to 4 days from stroke onset) reported high levels of anger and negative emotions preceding the cerebrovascular event
Post-stroke				
Author	Country and year	Number of patients	Study design	Main findings
Wang and Smyers (21)	USA, 1977	42	Case-control	More aggressive behaviour and trait anger after stroke
Paradiso et al. (22)	USA, 1996	18	Hospital-based population of patients who recently had a stroke	Higher levels of self-reported outbursts of anger (66%) than in controls (29.4%) More often these individuals had lesions in the left hemisphere Lesions close to the frontal lobe were related to more aggressive traits
Ghika-Schmid et al. (23)	Switzerland, 1999	53	Hospital-based population of patients who recently had a stroke	Fear and sadness were more frequent than anger in patients at the acute phase of stroke (studied over 4 days from stroke onset)
Kim et al. (24)	South Korea, 2002	145	Cross-sectional study with patients who recently had a stroke	Inability to control anger was observed in 32% of patients and it was related to depression, motor dysfunction, dysarthria, emotional incontinence and lesions affecting frontal-lenticulocapsular-pontine base areas
Santos et al. (25)	Portugal, 2005	202	Cross-sectional study with patients who recently had a stroke	Anger was detected in 35% of patients (36% of these had severe angriness) There was no correlation between anger and the area of brain lesion
Aybek et al. (26)	Switzerland, 2005	254	Cross-sectional study with patients who recently had a stroke	Anger and aggressive behaviour were associated to haemorrhagic lesions
Nakuthina et al. (27)	USA, 2006	24	Case-control study	Tendency for patients with right hemisphere lesions to recover poorly regarding emotional perception and expression
Choi-Kwon et al. (28)	South Korea, 2006	152	Trial with patients who had a stroke and were depressive	Clinical trial for showing the beneficial effect of fluoxetine in treating post-stroke emotional incontinence and anger proneness
Chang et al. (29)	USA, 2010	77	Trial comparing conventional and experimental therapies among patients with stroke	Clinical trial showing the beneficial effect of knowledge and behaviour therapy in anger control for patients with stroke
Choi-Kwon et al. (30)	South Korea, 2013	508	Hospital-based population of patients who recently had a stroke	Post- stroke anger proneness was observed in 15.1% of patients Previous stroke was associated to anger proneness
Toscano et al. (31)	Italy, 2014	25	Case-control study	Unexpected direct correlation between levels of serotonin and trait anger in stroke patients (serotonin assessed indirectly by evoked potentials)
Huang et al. (32)	Taiwan, 2014	178	Cross-sectional study with patients who had a stroke	Anger, helplessness, emotional liability, indifference, inertia and euphoria can all be found in patients who suffered a stroke
Farinelli et al. (33)	Italy, 2015	85	Case-control study	Posterior and lateral areas of the right brain hemisphere after stroke were correlated to trait anger

location, comorbidities, family life and social support may all have influenced the presence of 'anger' as an emotion in the studied subjects. Some of these confounders can be easily identified when, for example, population-based studies analyse data over just over 8 months (8,17), 24 months (15), and many years (14,16,18) of follow-up. Likewise, comparison of data between the general population (8,14–18) and hospitalised individuals (19,20) can generate confusion in the analyses. Data on patients who presented a stroke in different continents may generate further confounders, since there is no uniform health system care for these patients. The Table summarises data from patients with a stroke seen at the USA (21,22,27,29), Europe (23,25,26,31,33) and Asia (24,28,32). Cultural, dietary and religious habits from these different continents may render the results extremely difficult to compare when the outcome is the 'feeling' of anger.

Conclusion

The potential association between anger and stroke needs to be studied in a systematic manner in order to clarify the very important issues of prevention and sequelae. Many of these matters remain ill-defined. Further research should include large and multicenter databases, using uniform methods for patient evaluation.

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Conflicts of Interest

There are no conflicts of interests to declare.

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