Arq Neuropsiquiatr 2001;59(3-B):672-675

COMPARISON BETWEEN THE NASCET METHOD AND SUBJECTIVE VISUAL IMPRESSION IN THE EVALUATION OF INTERNAL CAROTID ARTERY STENOSIS

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ABSTRACT - *Objective*: To evaluate the accuracy of subjective visual impression (SVI) of an experienced neuro-radiologist in the measurement of the degree of internal carotid artery (IC) stenosis evaluated by digital angiography (DGA). *Method*: Ten symptomatic patients with internal carotid stenosis greater than 70% in a previous duplex scan were submitted to DGA. The degree of stenosis in both sides (symptomatic and asymptomatic) were evaluated by the same neuro-radiologist who gave his SVI and applied the NASCET method immediately after. Both methods were compared using the intraclass correlation coeficient (r) and its 95% confidence interval (95% ci). For each method, the sample (20 ICs) was also divided in surgical (stenosis between 70 and 99%) and non surgical ICs, using *kappa* concordance coeficient (k) to compare the results. *Results*: The results comparing the 20 values obtained by each method are: r = 0.90 (95% ci: 0.77 – 0.96). Dividing the sample in surgical and non surgical ICs, k = 0.857, p < 0.0001; sensitivity = 100% (39.6% - 100%); specificity = 93.8% (67.7% - 99.7%); positive predictive value = 80% (29.9% - 98.9%); negative predictive value = 100% (74,7% - 100%). *Conclusion*: The SVI may be used by at least some experienced neuroradiologists as a preliminary tool to evaluate the degree of IC stenosis with DGA, but a standardised and well established method should be routinely performed.

KEY WORDS: carotid stenosis, angiography diagnostic use, comparative study, cerebrovascular disease.

Comparação entre o método NASCET e impressão visual subjetiva na avaliação de estenose da artéria carótida interna

RESUMO - *Objetivo*: Avaliar a acurácia da impressão visual subjetiva (IVS) de um neurorradiologista experiente na mensuração do grau de estenose da artéria carótida interna (CI), avaliado pela angiografia digital (AGD). *Método*: Dez pacientes com estenose sintomática da CI maior que 70% ao *duplex scan* foram submetidos à AGD. O grau de estenose nos lados sintomático e assintomático foi avaliado pelo mesmo neurorradiologista, que aplicou sua IVS e logo após o método NASCET. Os métodos foram comparados utilizando-se o coeficiente de correlação intra-classe (r) e seu intervalo de confiança 95% (ic 95%). Para cada método, a amostra foi dividida em cirúrgica – CI com estenose de 70% a 99% - e não cirúrgica, e o coeficiente kappa de concordância (k) foi usado para comparar os resultados. *Resultados*: Comparando-se os 20 valores obtidos por cada método, r = 0,90 (ic 95%: 0,77 – 0,96). Após dicotomização da amostra, obteve-se k = 0,857, com p < 0,0001; sensibilidade = 100% (39,6% - 100%); especificidade = 93,8% (67,7% - 99,7%); valor preditivo positivo = 80% (29,9% - 98,9%); e valor preditivo negativo = 100% (74,7% - 100%). *Conclusão*: A IVS pode ser usada por pelo menos alguns neurorradiologistas experientes como método de avaliação preliminar do grau de estenose da CI por AGD. Um método padronizado e bem estabelecido cientificamente deve ser, entretanto, aplicado rotineiramente.

PALAVRAS-CHAVE: estenose carotídea, angiografia uso diagnóstico, estudo comparativo, transtornos cerebrovasculares.

Since the beginning of the twentieth century, Chiari (1906) and Hunt (1914) have shown, in autopsies, the role of extracranial internal carotid artery (IC) in the mechanism of stroke, relating it to IC occlusion[1]. On October 1951, Carrea et al. performed the first carotid reconstruction, influenced by Miller Fisher's studies about carotid occlusion and stroke[1,2]. In 1954, Eastcott et al. made the first endarterectomy, with atherosclerotic plaque resection and reconstruction of the common carotid artery and the IC and their anastomosis[2]. Endarterectomy became a popular procedure during the 1970 and 1980 decades[1-4]. Nevertheless, the procedure lacked scientific proof of efficacy and reports of severe complications appeared frequently[2].

Preliminary results of important multicentric trials on symptomatic patients were published in the 1990 decade, notably the North American Symptom-

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Received 1 February 2001, received in final form 4 May 2001. Accepted 14 May 2001.

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atic Carotid Endarterectomy Trial (NASCET)[5] and the European Carotid Surgery Trial (ECST)[6]. These trials demonstrated no benefit from endarterectomy in mild IC stenosis – less than 30%. On the other hand, in severe IC stenosis – equal or greater than 70% - benefits of the procedure were clear[5,6]. Recently, final results of both trials were published[7,8]. ECST[7] concluded that endarterectomy should only be indicated if the degree of IC stenosis was equal or greater than 80%. NASCET[8] found that endarterectomy was reliable if this degree was equal or greater than 70% and in selected patients with 50% to 69% stenosis.

Discussion emerged about different cut-points between these two trials. It became clear that differences could be explained by distinct methods to measure IC stenosis, although both trials have used digital angiography (DGA) criteria[3,9]. The NASCET method calculated the degree of IC stenosis by dividing the vessel lumen diameter in the narrowest zone of stenosis by the diameter of the IC distal to the stenosis, in an area free of angles[5]. The ECST proceeded by dividing the same artery lumen diameter in the narrowest zone of stenosis by the estimated original lumen diameter of the carotid bulb[6]. Both techniques were criticized[10,11]. The NASCET method, for instance, may find negative values for IC stenosis, if the remaining carotid bulb lumen diameter is greater than that of the distal IC; and ECST uses a subjective criteria to evaluate the original carotid bulb diameter[10]. Apparent discrepancies in cut-points of NASCET and ECST were compared and it was found that there is a straight correspondence between their results, as showed in Table 1[3,9]. For instance, a 60% degree of stenosis in NASCET corresponds to a 80% stenosis in ECST[3]. Other authors suggested a new method to measure IC stenosis[10]. They consider carotid bulb diameter as 1.2 the diameter of common carotid artery in a region three to five centimeters proximal to the bulb. Then, the following formula is applied: (1 – D / N) x 100%, where D is the stenosed lumen diameter and N the estimated normal carotid bulb diameter[10]. There is no agreement in literature on the best method to measure IC stenosis. Some authors even suggest that, in clinical practice, most radiologists do not use any published method, preferring only a subjective visual impression (SVI) of the degree of IC stenosis[12].

In the present study, the authors compare a well established and widely used[9,11] angiographic method – NASCET[5] - to measure the degree of IC stenosis with the SVI of an experimented neuroradiologist (FSA). The main objective is to calculate their correlation and concordance rates.

Table 1. Corresponding degrees of carotid artery stenosis (%) in NASCET and ECST.

NASCET	ECST
30	65
40	70
50	75
60	80
70	85
80	91
90	97

From: Dowman et al.[3]

METHOD

This is a prospective, longitudinal study with consecutive patients and data collection between June 1997 and September 1999. Ten consecutive patients from a university hospital selected to another study[13] - agreed to participate. In summary, the inclusion criteria were: age up to 80 years; history of transient ischemic attack (TIA) or mild stroke – Rankin scale[14] up to grade two – in the ipsilateral IC territory; a previous DS showing IC stenosis equal or greater than 70% in one or both extracranial IC; and informed consent. The exclusion criteria included kidney, liver or lung failure or cancer leading to expected survival less than five years; extensive previous stroke; severe diseases that could increase the risk of the endarterectomy; any additional contraindication to surgery. Addering to the ECST criteria, the maximum interval between the neurological event and DGA was six months[6,7].

DGA was made in a Stenoscop (General Electric) machine, using the Seldinger technique by femoral artery catheterization and performed by the same examiner (FSA). All four cervical arteries and the intracranial vessels were studied. The neuroradiologist first gave his SVI and then immediatly applied the NASCET method[5].

For statistical analysis, a graphic measuring the dispersion of the values through a given line and comparing the obtained values in each measurement method was created, as suggested[15]. If there is a perfect correlation between comparing values, all points will be on the given line; the more distant from the line, the more discordant are the values. Intraclass correlation coefficient (r) was also calculated to the numeric results, measuring the correlation between SVI and the NASCET method[15]. The 95% confidence interval (95% ci) was calculated, determining limits of correlation with a 5% error. Sample size and variability of results are taken into account in 95% ci calculation.

To increase the utility of the study in clinical practice, we divided the sample in surgical – 70% to 99% IC stenosis - and non-surgical – less than 70% stenosis or total occlusion. *Kappa* concordance coefficient (k) and its p value were calculated to the obtained groups. *Kappa* co-

Table 2. Comparison between subjective visual impression and the NASCET method in measuring the degree of internal carotid artery stenosis (%) studied by digital angiography.

Patient	NASCET method		Subjective visual impression	
1. GC	R: 54,5%	L: 0%	R: 60%	L: 0%
2. TB	R: 87,5%	L: 0%	R: 90%	L: 0%
3. NCO	R: 85%	L: 30%	R: 85%	L: 30%
4. JAV	R: 100%	L: 83%	R: 100%	L: 90%
5. GLF	R: 0%	L: 50%	R: 0%	L: 50%
6. ACS	R: 0%	L: 70%	R: 0%	L: 70%
7. MC	R: 25%	L: 25%	R: 25%	L: 25%
8. AAS	R: 100%	L: 0%	R: 100%	L: 0%
9. MCD	R: 33%	L: 40%	R: 30%	L: 50%
10. MNCC	R: 100%	L: 54%	R: 100%	L: 80%

R, right; L, left.

efficient measures observed concordance, excluding concordance by chance[16,17]. Sensitivity, specificity, positive predictive value and negative predictive value were also calculated for SVI, with their 95% ci. Values of "r" and "k" were classified as bad (less than 0.4), good (0.4 to 0.75) or excellent (greater than 0.75), following Landis and Koch's criteria[18].

Besides global comparison of the results, an analysis of each case was made, considering differences greater than 10% between the results were considered to indicate discordance, and differences less than 10% as indicating concordance. This level of difference (10%) was chosen because it is outside the range of measurement error[19] and because meaningful increments in stroke risk occur between decile levels[20].

RESULTS

Ten patients – 20 ICs – were studied. Their clinical presentation and course have been fully described[13]. Table 2 shows the main numeric values obtained. Figure 1 shows a graphic with plotted values of both measurement methods.

Intraclass correlation coefficient (r) was 0.90 (95% ci = 0.77 – 0.96). Dividing the sample in surgical and non-surgical ICs, k = 0.857 ($p < 0.0001$); sensitivity of SVI was 100% (39.9% - 100%); specificity = 93.8% (67.7% - 99.7%); positive predictive value = 80% (29.9% - 98.9%); and negative predictive value = 100% (74.7% - 100%).

DISCUSSION

There is still controversy in the international literature about the best way to measure the degree of extracranial IC stenosis using DGA. The two main studies on endarterectomy – NASCET[5] and ECST[6] – used different methods to perform this measurement. There is indeed a way to compare the results of each of such studies (Table 1)[3]. Alternative forms to measure the degree of IC stenosis have already been described[10]. Some authors emphasize that most radiologists do not use any of these methods in daily practice, depending instead only on their SVI[12].

Using material generated in another study[13], the authors made a direct comparison between SVI of an experienced neuro-radiologist (FSA) and a well established method to measure IC stenosis – the NASCET method[5]. There was an excellent correlation between the obtained numeric values. There was also little dispersion of values in the graphics with plotted results (Fig 1). When the sample was arbitrarily divided in surgical and non-surgical IC, concordance was also shown to be excellent, the same applying to sensitivity, specificity, positive and negative predictive values. Nineteen calculations were higly correlated (differences less than 10% between the stud-

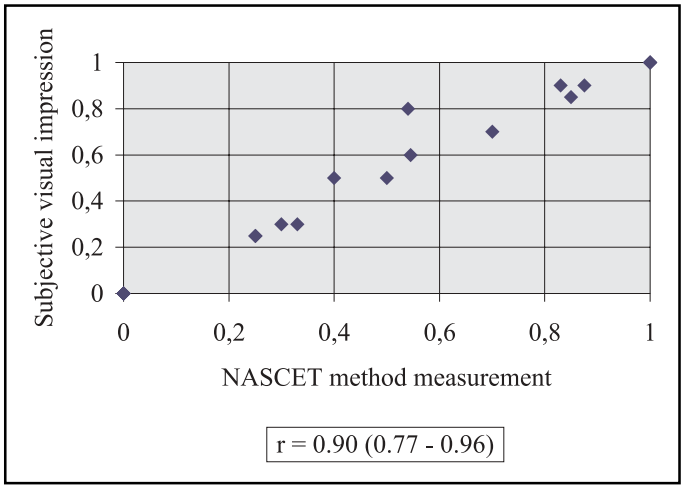

Fig 1. Graphic comparing the results (degree of carotid artery stenosis in digital angiography - %) using the NASCET method and subjective visual impression.

Fig 2. Digital angiography with discordance between the NASCET method (54%) and subjective visual impression (80%) in the evaluation of the degree of internal carotid artery stenosis (patient 10 – MNCC).

ied methods). One patient, however, would be referred to endarterectomy by the SVI method but not if the NASCET criteria were used. In this case, the SVI found an 80% degree of IC stenosis and the NASCET method found a 54% stenosis (Fig 2). We must comment, however, that following NASCET's final results[8] and using only anatomic criteria, this patient would possibly be submitted to endarterectomy anyway.

We must recognize that the results presented here have large confidence intervals, reflecting the small sample size. Thus, this study should be continued to increase the number of studied patients and reduce the chance of error.

In conclusion, the SVI may accurately measure the degree of extracranial IC stenosis, studied by DGA, as compared to the NASCET method. SVI, as performed by at least some experienced neuroradiologists, may be used as a preliminary tool to evaluate IC stenosis, studied by DGA. Nevertheless, a standardised and well established method to perform this measurement is imperative in daily clinical practice and should always be applied.

Acknowledgements – We are in debt with Professor Ronir Raggio Luiz for his planning of the statistical analysis.

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