Intra- and inter-observer variability in the angiographic delineation of brain arterio-venous malformations (AVMs)

René Anxionnat, Marie-Odile Berger, Erwan Kerrien, Serge Bracard, Luc Picard

Intra- and inter-observer variability in the angiographic delineation of brain arterio-venous malformations (AVMs)

R. Anxionnat[ab], M.O. Berger[a], E. Kerrien[a], S. Bracard[b], L. Picard[b].
[a]LORIA, Campus scientifique, BP 34; 54506 Vandoeuvre les Nancy cedex, France
[b]Service de Neuroradiologie, Hopital Neurologique ; 29, av. du Mal de Lattre de Tassigny ; 54035 Nancy cedex, France.
r.anxionnat@chu-nancy.fr tel (0033) 3 83 85 22 03

Introduction. The purpose of this study is to determine the intra- and inter-observer variability in the manual delineation of the boundaries of brain arterio-venous malformations (AVMs) on digital subtracted angiograms. Such delineation is used to define the target volume in stereotactic radiotherapy.
Materiel and methods. Twenty brain AVMs were delineated each twice by 3 neuroradiologists in X-ray angiograms. The variability was assessed by a pair-wise comparison of the 6 contours obtained for each AVM angiograms using the similarity index , the Hausdorff distance and the mean distance [1]. Point to point correspondence between two contours was established thanks to a semi-automated method. The mean distance was then calculated as the mean of the Euclidian distance between each corresponding points after by. As a result, 3 intra-observer and 12 inter-observer measurements were obtained for each AVM and for each of the above comparison measures.
Results. Table 1 shows the results averaged on the 20 AVMs. Similarity indices above 0.7 indicate a good agreement between experts. The distances are given in pixels (angiograms are 1024x1024 images). Knowing the approximated magnification factors in the angiograms enabled to infer an approximation of the distance values in millimeters (in parentheses).

	Similarity Index	Mean distance	Hausdorff distance
Intra-observer	0.85	13.27 px (2.0 mm)	37.53 px (5.7 mm)
Inter-observer	0.88	15.39 px (2.3 mm)	44.72 px (6.7 mm)

Discussion. The mean distance was found to be around 2 mm. An upper bound error of 1 mm is generally admitted for the whole stereotactic procedure [2]. Therefore, our study proved that the manual delineation step in such procedures is an important factor which is widely under-estimated (to our knowledge, no study was ever performed to assess its impact). Moreover the big discrepancy between Hausdorff and mean distances showed that the differences in the delineation were not regularly distributed around the contours. Visual assessment of the variability confirmed that high variation areas alternate with consensus segments on the contours for each AVM. This preliminary work shows that the comparison between two contours must be evaluated on a local basis in order to discern the sources of variability and control them.
References
[1] V. Chalana and Y. Kim. A methodology for evaluation of boundary detection algorithms on medical images. IEEE Transactions on Medical Imaging, vol.16, no. 5, pp. 642-652, 1997
[2] Evaluation clinique et économique de la radiochirurgie intracranienne en conditions stereotaxiques. Rapport de l'ANAES mai 2000.