Effect of computer-aided diagnosis system on diagnostic accuracy and reading time in detection of intracranial aneurysms on MR angiography

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PURPOSE:

Recently, computer-aided diagnosis (CAD) system with automated detection methods for intracranial aneurysms in screening by MR angiography have been developed, and the findings from observer studies demonstrated that the use of the CAD system substantially improved the accuracy of detecting intracranial aneurysms both for neuroradiologists and for general radiologists (1-3). However, these reports emphasized improvements in diagnostic accuracy, whereas the effect of the CAD system on the reading time has not been evaluated. Our hypothesis was that CAD systems can shorten the reading time while maintaining a high diagnostic performance of radiologists in the detection of intracranial aneurysms on MR angiograms. Our purpose in this study was to verify the hypothesis by using an observer performance study without and with the CAD system.

MATERIALS AND METHODS:

Fifty maximum intensity projection MR angiograms in 50 patients (16 cases with intracranial aneurysms and 34 negative cases) were used for observer performance study. The performance level in this CAD system was a detection sensitivity of 82.5% with an average of 3.06 false-positive detections per image (Figure 1). The MR angiograms were obtained with three-dimensional time-of-flight 1.5-T MR imaging. Sixteen radiologists (8 neuroradiologists and 8 less experienced radiologists) participated in observer tests and interpreted the MR angiograms without and with the CAD outputs by using an independent test method. The reading time for each reader was recorded in each case. The reading time was automatically measured from the moment that the radiologist first viewed the images (when the MR angiograms were displayed) to the moment that the radiologist marked his or her confidence level. The observers' performance was evaluated by use of receiver operating characteristic (ROC) analysis.

RESULTS:

For the neuroradiologists, the observer performance with CAD outputs (Az = 0.895) was not improved with statistical significance compared to that without CAD outputs (Az = 0.914), and the mean reading time per case also did not decrease significantly (54.5 sec without CAD vs 50.7 sec with CAD, p=0.084). For the less experienced radiologists, however, the average Az value increased significantly from 0.787 without to 0.911 with CAD outputs (p=0.022) (Table 1). For the less experienced radiologists, the mean reading time per case with CAD outputs was reduced significantly from 59.3 sec to 39.0 sec for the aneurysm cases (p<0.01), and from 78.4 sec to 40.2 sec for negative cases (p<0.01). The Az value for the less experienced radiologists using CAD outputs was almost equal to that for the neuroradiologists, and the reading time of less experienced radiologists with CAD outputs was significantly shorter that of neuroradiologists without CAD outputs (p<0.01).

Table 1. Diagnostic performance according to each observer

	Az	
	without CAD	with CAD
neuroradiologists		
A	0.917	0.918
B	0.985	0.951
C	0.958	0.905
D	0.869	0.812
E	0.897	0.863
F	0.861	0.908
G	0.887	0.899
H	0.944	0.904
Average	0.914±0.018	0.895±0.001
less experienced		
I	0.896	0.870
J	0.766	0.965
K	0.726	0.990
L	0.828	0.794
M	0.837	0.890
N	0.718	0.920
O	0.723	0.940
P	0.797	0.922
Average	0.787±0.022	0.911±0.017*
Overall average	0.851±0.085	0.903±0.051

Note.-Data of the average are means ± SDs
*P=0.022 Dorfman-Berbaum-Metz method

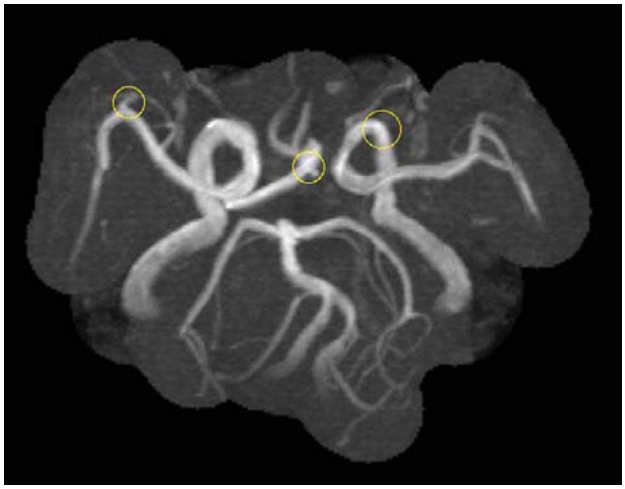

Figure 1. CAD output image (inferior view) indicates three suspicious areas (circles). One area contains an actual intracranial aneurysm of the anterior communicating artery, and others contain false positives.

CONCLUSION:

The use of the CAD system significantly shortened the reading time and improved the diagnostic accuracy for less experienced radiologists, but not for neuoradiologists. Our future challenge is to improve the performance level of this CAD system to a level comparable to, or higher than, the performance level of neuoradiologists.

References:

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