Performance evaluation of Artificial Intelligence-based technology for fast and accurate bolus-tracking process in Coronary CT angiography

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Background

Process of bolus-tracking scans before CT angiography usually include monitoring location selection and region-of-interest (ROI) placement to generate time-density curve (TDC) triggering the CTA scan.

Purpose

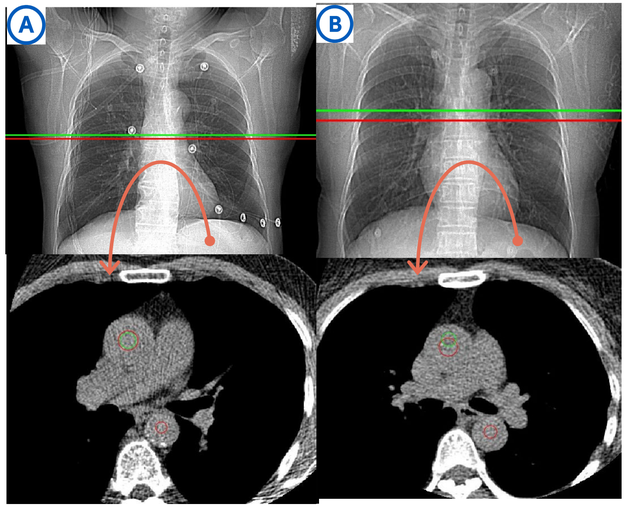
In this study we aimed to evaluate the performance of an artificial intelligence-based technology (SmartPlan, GE Healthcare) for fast and accurate bolus-tracking process compared with manual operation by technicians.

Methods

50 CTA scans including coronary CTA performed using the SmartPrep triggering technique were prospectively collected.

Artificial Intelligence-based technology

- The monitoring location for placing ROI by CT technicians for dynamic contrast-enhancement monitoring in bolus-tracking scans and TDC generated in the ROI were recorded as the control group;
- The scout scans and time-resolved images were then imported into the SmartPlan software to automatically determine the monitoring location for placing ROI and to generate TDC, the results were recorded as the experimental group.



The monitoring level placed by both the AI and the doctor was one centimetre below the bronchial bulge; however, on the monitoring level ROI outlining the AI defaults to the cardiac scan will output two ROIs: the ascending and descending aortic positions, and the position used by the doctor is the approximate position of the ascending aorta from the monitoring level (red is the output from deep learning, green is the result from the doctor).

Data Analysis

A. The consistency and time consuming of the location selection and the peak value of TDC curve triggering the scan between the experimental and control groups were analyzed using paired sample t-test.

B. $P < 0.05$ was considered statistically significant.

Results

There was significant difference in monitoring position between the experimental group (-90.19±28.47mm) and control group (-93.15±26.22mm) ($P<0.05$). However, there was no difference in the peak value of TDC curves between the experimental group (169.6±30.9) and the control group (167.9±25.5) ($P=0.784$).

Time consuming were found significant decreased in the experimental group compared with the control group (0.6s vs 19.9s) ($P<0.05$).

	Control group	Experimental group	P Value
monitoring position (mm)	-93.15±26.22	-90.19±28.47	P<0.05
Transverse coordinates of the circle of the ascending aortic ROI (mm)	170.06±25.9	169.75±25.01	0.518
Vertical coordinatesof the circle of the ascending aortic ROI (mm)	243.06±50.62	247.38±50.68	0.036
Radius of ascending aortic ROI (mm)	13.69±5.47	13.75±2.44	0.96
Transverse coordinates of the circle of the descending aortic ROI (mm)	-	239.76±23.71	-
Vertical coordinatesof the circle of the descending aortic ROI (mm)	-	397.17±39.74	-
Radius of the descending aortic ROI (mm)	-	9.59±1.91	-
peak value of TDC curves	167.9±25.5	169.6±30.9	0.784

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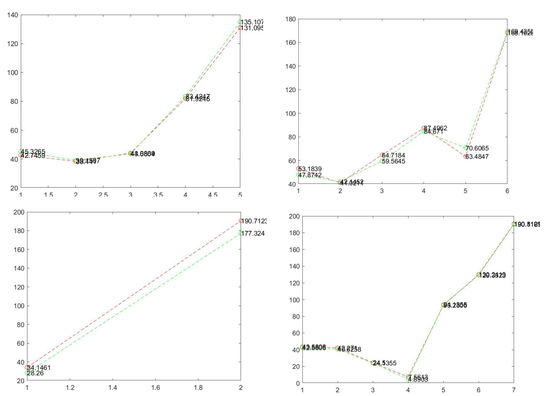

The time density curves corresponding to the monitoring of ROI are in red for deep learning and in green for doctors.

Conclusion

The AI-based automatic bolus-tracking technique can simplify CT scan process and physician intervention to provide reliable information for automatically triggering coronary CTA scans.

Clinical relevance / Application: The intelligent automatic bolus-tracking technique based on deep learning neural network may reduce the manual intervention and simplify the process of automatically triggering coronary CTA.

References

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