Impact of Artificial Intelligence-based Optimization Algorithm on Image Quality of low-dose Coronary CT Angiography

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Aims and objectives

To assess the impact of an artificial intelligence (AI)-based optimization algorithm on image quality (IQ) in low-dose (LD) Coronary CT Angiography (CCTA).

Methods and materials

Seventy subjects referred for CCTA were randomly divided into two groups (group A with 80 kVp and group B with 100 kVp) on NeuViz 128 CT. Group A was divided into two subgroups (A1, A2) according to reconstruction algorithm. Iterative reconstruction (IR) was applied to group A1 and B. Further AI-based optimization of group A1 was named as group A2. Subjective IQ was graded blindly by two radiologists with a four-point scale (1 for excellent and 4 for poor). Image noise, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated to evaluate IQ objectively.

Results

The subjective IQ score of group A2 was significantly lower than that of group A1(P= 0.03). The image noise of group A2 was significantly decreased while SNR and CNR were significantly increased than that of group A1(P< 0.001). Compared with group B, the subjective IQ score of group A1 was significantly higher (P= 0.004) while that of group A2 has no significant difference (P= 0.899). For objective IQ, the image noise of group A1 was significantly higher while SNR and CNR were significantly lower than that of group B (P< 0.05). There was no significant difference in noise and SNR between group A2 and group B (P> 0.05), but CNR in group A2 was significantly higher than that in group B (P< 0.05) on coronary branches.

Images for this section:

Characteristics	Group A (n=35)	Group B (n=35)	P-value
Age (years)	59.80 ± 10.70	56 (54 - 63)	0.09
Gender (male, %)	20 (57%)	17 (49%)	0.47
Height (m)	1.65 ± 0.08	1.66 ± 0.07	0.51
Weight (kg)	62.88 ± 10.00	68.67 ± 13.25	0.07
BMI (kg/m^2)	23.01 ± 2.77	24.78 ± 4.60	0.09
Heart rate (bpm)	66.77 ± 8.05	66 (65 - 71)	0.90
Scan length (mm)	125.00 (120.00-132.00)	126.50 (120.00-133.00)	0.91

Fig. 1

ROI	Noise			SNR			CNR		
	Group A1	Group A2	Group B	Group A1	Group A2	Group B	Group A1	Group A2	Group B
Ao	30.12 ± 9.53*#	9.53 ± 2.65**	16.90 (15.08 – 20.80)	17.94 (15.21 - 26.94)*#	57.14 (49.50 - 79.22)**	28.66 ± 10.39	27.82 (24.14 - 38.97)*#	72.22 (50.11 - 112.15)**	40.79 ± 14.74
LM	33.90 ± 16.94*#	17.60 (13.93 - 22.20)	18.80 (15.80 - 20.60)	17.85 (13.36 - 26.43)*#	28.75(23.40- 43.63)	26.15 ± 8.21	26.72 (22.32 - 38.76)*#	70.56 (47.58 - 102.66)**	39.86 ± 15.45
LAD	27.50 (18.03 - 33.50)*#	18.00 (11.18 - 25.60)	18.60 (16.83 - 21.10)	20.28 (14.60-25.63)*#	28.17 (16.11 - 43.44)	25.17 (20.53 - 31.84)	26.62 (19.46 - 37.30)*#	67.57 (44.91 - 98.57)**	38.94 ± 13.70
LCX	29.30 ± 12.12*#	21.35 ± 11.98	21.00 (17.33 - 24.90)	19.88 (15.99 - 21.98)*#	24.72 (17.80 - 38.16)	23.49 (19.00-28.99)	25.32 (19.76 - 34.32)*#	63.77 (44.70 - 108.12)**	39.16 ± 14.00
RCA	25.80 (22.03 - 37.30)*#	16.90 (11.73 - 29.10)	19.50(14.40-23.50)	17.58 (12.11 - 25.43)*#	28.06 (14.70 - 51.33)	23.54 (20.46 - 30.16)	25.04 (18.82 - 33.90)*#	58.88 (43.74 - 95.32)**	38.22 ± 12.65

Fig. 2

Group No.	Segment number	1 Score		2 Score		3 Score		4 Score		Kappa Value
		Reader 1	Reader 2	Reader 1	Reader 2	Reader 1	Reader 2	Reader 1	Reader 2	
Group A1	414	133(32.13%)	130(31.40%)	242(58.45%)	245(59.18%)	29(7.00%)	29(7.00%)	10(2.42%)	10(2.42%)	0.78
Group A2	414	188(45.41%)	178(43.00%)	198(47.83%)	208(50.24%)	18(4.35%)	18(4.35%)	10(2.42%)	10(2.42%)	0.81
Group B	429	180(43.48%)	174(42.03%)	216(50.35%)	223(51.98%)	21(4.90%)	20(4.66%)	12(2.80%)	12(2.80%)	0.78

Fig. 3

Radiation dose	Group A (n = 35)	Group B (n = 35)	P-value
$CTDI_{vol}$ (mGy)	4.65 ± 1.00	12.49 ± 3.81	< 0.001
DLP (mGy•cm)	66.61 ± 15.37	150.19 ± 28.94	< 0.001
ED (mSv)	0.91 ± 0.22	2.10 ± 0.41	< 0.001
CM volume (mL)	44.46 ± 7.00	70	NA
Injection rate (mL/s)	3.18 ± 0.50	5	NA

Fig. 4

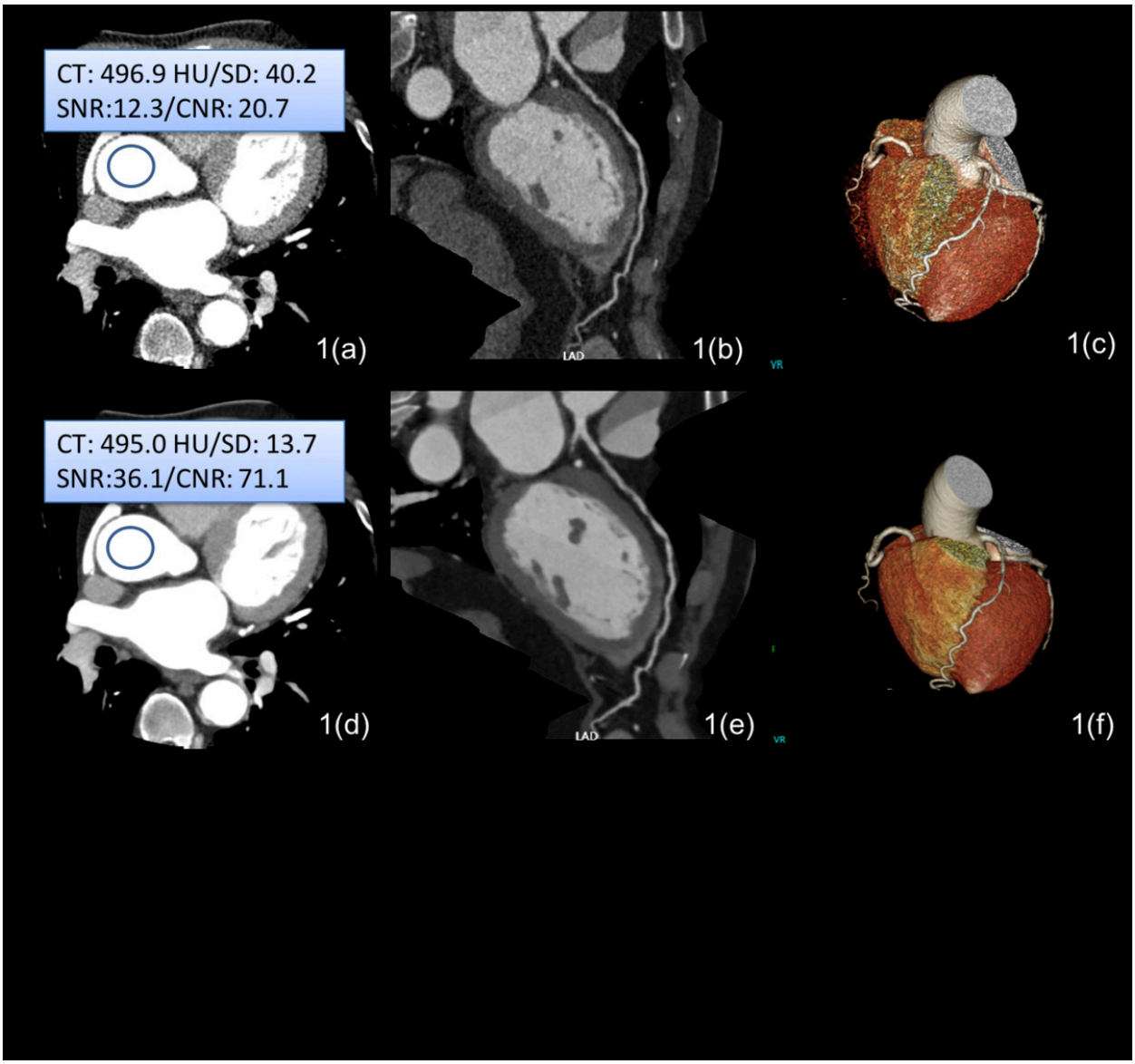

Fig. 5

Conclusion

The AI-based optimization algorithm could effectively improve IQ of LD CCTA.

Personal information

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References

1. Raff GL, Abidov A, Achenbach S, Berman DS, Boxt LM, Budoff MJ, et al. (2009) SCCT guidelines for the interpretation and reporting of coronary computed tomographic angiography. J Cardiovasc Comput Tomogr 3(2):122-36.

2. Yi Y, Cao J, Lin L, Jia Y, Liu JM, Wang M, et al. (2017) A preliminary study on a 70 kV high- pitch dual- source CT coronary angiography using an ultra- low contrast media. International Journal of Clinical and Experimental Medicine 10(4):6237-49.

3. Cademartiri F, Maffei E, Arcadi T, Catalano O, Midiri M (2013) CT coronary angiography at an ultra-low radiation dose (<0.1 mSv): feasible and viable in times of constraint on healthcare costs. Eur Radiol 23(3):607-13.

4. Zhang LJ, Wang Y, Schoepf UJ, Meinel FG, Bayer RR, Qi L, et al. (2015) Image quality, radiation dose, and diagnostic accuracy of prospectively ECG-triggered high-pitch coronary CT angiography at 70 kVp in a clinical setting: comparison with invasive coronary angiography. European Radiology 26(3):797-806.

5. <A preliminary study on a 70 kV high-pitch dual-source CT coronary angiography using an ultra-low contrast media.pdf>.