Plaque Characterization

syngo Dual Energy Hardplaque Display

With simultaneous dual energy scanning, automated plaque detection and characterization has become viable. The first step is to reliably differentiate calcified plaques from the contrast-opacified lumen of the vessel. The new *syngo* Dual Energy Hardplaques algorithm helps to differentiate plaque from iodine by color-coding both differently. This aim is accomplished better than with the bone removal algorithm, because this algorithm is designed to differentiate and mark calcium and iodine rather than completely removing calcium-containing structures from the dataset. Thus, the plaque load becomes obvious and it is possible to quantify atherosclerotic lesions, for example, to monitor treatment response to statin therapy. Also, the visual grading of calcified stenoses can be improved, because the algorithm helps to delineate plaque and lumen more exactly. Additionally, this data can be used to improve the automatic grading of stenoses by postprocessing software.

The algorithm can also be used to differentiate calcification from contrast enhancement or to visualize an additional contrast enhancement in calcified lesions. This can be helpful, for example, to identify endoleaks in a partially calcified thrombosed false lumen after endovascular repair of aneurysms or dissections. In calcified lesions of liver or spleen, for instance, metastases or parasitic cysts, the algorithm can be used to assess contrast enhancement even without an additional unenhanced scan.

Case 1 – Carotid Plaques

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History

A 63-year-old hypertensive patient presented with transient amaurosis fugax and aphasia for eight hours. MRI angiography was not possible due to a cardiac pacemaker.

Diagnosis

Abnormal anatomic findings of the carotid arteries were excluded. Fused dual energy images showed calcified plaques at both carotid bifurcations. A severe vascular stenosis due to calcified or soft plaque was ruled out.

Comments

Dual Energy CTA makes a differentiation of iodine-filled vessel lumina from calcified vessel plaques feasible, making a more accurate quantification of carotid stenosis possible. Color-coded visualization further simplifies diagnosis and presentation.

Examination Protocol

Scanner	SOMATOM Definition
Scan area	aortic arch to circle of Willis
Scan length	250 mm
Scan time	4 s
Scan direction	caudocranial
kV	140 kV and 80 kV
Effective mAs	55 mAs and 234 mAs
Rotation time	0.33 s
Slice collimation	0.6 mm
CTDIvol	9.1 mGy
Pitch	0.7
Sex	F
Contrast	
Contrast material	Ultravist 370
Volume	80 ml
Flow rate	5 ml/s
Start delay	2 s after trigger
Saline chaser bolus	50 ml, 5 ml/s
Postprocessing application	
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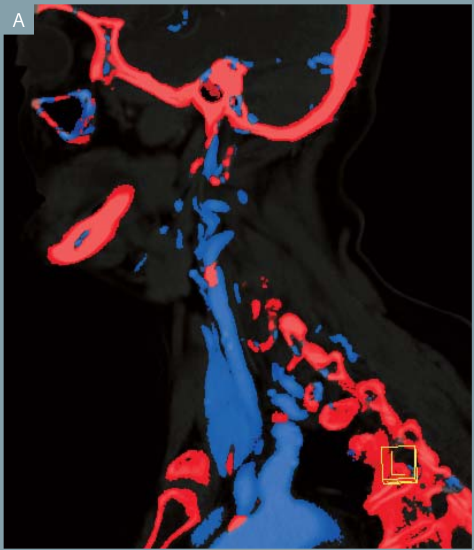
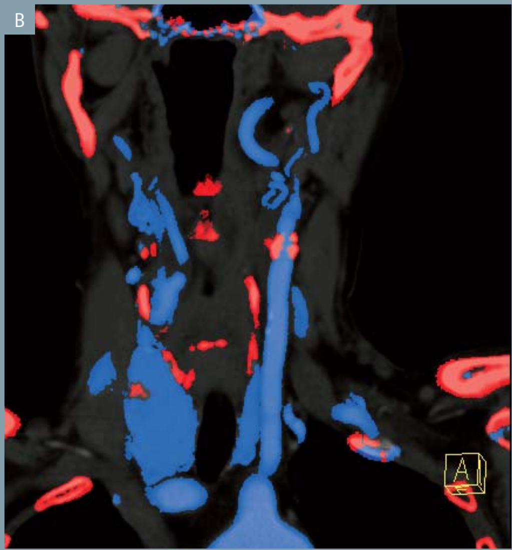
A



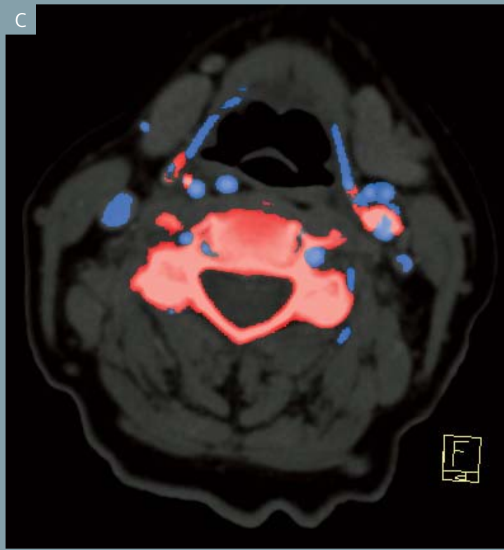
[A] Axial dual energy image of a calcified plaque at the bifurcation of the left carotid artery. Note the differentiation of iodine (blue) and calcium (red).

B



[B] Coronary dual energy image (MPR) of the same plaque.

C



[C] Sagittal dual energy image (MPR) of the same plaque.

Case 2 – Aortic Stent

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History

A 45-year-old male patient was referred for follow-up one year after endovascular repair of an aortic aneurysm.

Diagnosis

Aortic angiography showed a stent in the descending thoracic aorta. Hyperdense material was noted in the thrombosed part of the lumen outside the stent. There was no connection to the proximal or distal end of the stent. The hardplaques algorithm color-coded these areas as iodine, confirming an endoleak type III.

Comments

The hardplaques algorithm is helpful to clearly differentiate calcifications from contrast enhancement. The single phase acquisition in dual energy technique was sufficient to make the diagnosis in this case.

Examination Protocol

Scanner	SOMATOM Definition
Scan area	thorax
Scan length	350 mm
Scan time	8 s
Scan direction	craniocaudal
kV	140 kV and 80 kV
Effective mAs	50 mAs and 214 mAs
Rotation time	0.5 s
Slice collimation	14 x 1.2 mm
CTDIvol	11.1 mGy
Sex	M
Contrast	
Contrast material	Ultravist 370
Volume	120 ml
Flow rate	4 ml/s
Start delay	5 s after trigger
Saline chaser bolus	50 ml, 4 ml/s
Postprocessing application	
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[A] Volume-rendered image showing the contrast-opacified aorta with the stent.

[B] Maximum intensity projection visualizing the struts of the stent.

[C + D] Axial and coronal images showing some hyperdense material on the right side of the stent in the thrombosed lumen.

[E + F] Axial and coronal color-coded result images of the hardplaques algorithm. The hyperdense material is identified as iodine, confirming an endoleak.