New Techniques in CT Angiography and its Clinical Impacts

Essay
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Dedication

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LIST OF ABBREVIATIONS

ACA	Anterior Cerebral Artery
AChA	Anterior Choroidal Artery
ACoA	Anterior Communicating Artery
AICA	Anterior Inferior Cerebellar Artery
BA	Basilar Artery
BUN	Blood Urea Nitrogen
BW	Body Weight
CA	Celiac Axis
CCA	Common Carotid Artery
CE	Contrast Enhanced
CHA	Common Hepatic Artery
CIN	Contrast medium–Induced Nephrotoxicity
CM	Contrast Medium
CNR	Contrast-to-Noise Ratio
CPR	Curved Planar Reformations
CT	Computed Tomography
CTA	Computed tomographic angiography
CTPA	Computed Tomographic Pulmonary Angiography
CTV	Computed Tomographic Veinography
DSCT	Dual-Source CT
ECA	External Carotid Artery
ECG	Electrocardiogram
FFS	Focal Spot
FOV	Field-Of-View
FWHM	Full Width at Half Maximum
Gd	Gadolinium

GDA	Dastroduodenal Artery
GFR	Glomerular Filtration Rate
HU	Hounsfield Units
ICA	Internal Carotid Artery
IEC	International Electrotechnic Commission
IMA	Inferior Mesenteric Artery
ISO	International Organization for Standardization
IVC	Inferior Vena Cava
IV	Intravenous
lp/cm	line pairs per cm
LAD	Left Anterior Descending Artery
LCX	Left Circumflex artery
LGA	Left Gastric Artery
MCA	Middle Cerebral Arteriy
MDCT	Multi-detector row CT
Min	minute
MinIP	Minimum Intensity Projection
MIP	Maximum Intensity Projection
MMBE	Matched Mask Bone Elimination
MPR	Multiplanar Reformation
MRA	Magnetic Resonance Angiography
MRI	Magnetic Resonance Imaging
MSCT	Multislice CT
MTF	Modulation Transfer Function
NSAID	Nonsteroidal Anti-Inflammatory Drugs
P	Pitch
PAD	Peripheral Arterial Disorders
PCoA	Posterior Communicating Artery
PE	Pulmonary Embolism
PICA	Posterior Inferior Cerebellar Artery
PICC	Peripherally Inserted Central venous Catheters
PSF	point spread function

RCA	Right Coronary Artery
RI	Reconstruction Increment (mm)
ROI	Region-Of-Interest
SC	Section Collimation (mm)
SCA	Superior Cerebellar Artery
SFOV	Scan Field Of View
SMA	Superior Mesenteric Artery
SSD	Shaded-Surface Display
SSPs	Slice Sensitivity Profiles
SSS	Superior Sagittal Sinus
SW	Section Width (mm)
t_{CMT}	contrast medium transit time
VA	Vertebral Artery
VR	Volume Rendering
TF	Table Feed per tube rotation (mm)
TS	Transverse Sinus

INTRODUCTION

Computed tomographic angiography (CTA) is one of the big success stories in diagnostic radiology. CTA was developed shortly after the introduction of spiral (helical) CT scanning in the early 1990s.

Spiral CT had made it possible to cover body regions so rapidly that the transient enhancement of the vascular system following intravenous contrast injection could be captured during one scan. With the introduction of multidetector-row technology, CTA gained a tremendous boost and quickly became an easy-to-perform standard technique for vascular imaging. Over the years, CTA—together with magnetic resonance angiography—has taken over most diagnostic vascular procedures from invasive catheter angiography, first for the aorta and the pulmonary arteries; later for the carotids, renal, and splanchnic arteries; and recently also for peripheral arteries and the circle of Willis. Most recently, CTA of the coronaries has been developed. While coronary CTA is still technically challenging, it also holds the promise to substitute for part of diagnostic cardiac catheter angiographies. ***(Rubin and Rofsky, 2009)***

A variety of techniques have been proposed for postprocessing of the resulting images.

The most widely used techniques are multiplanar reformation (MPR), thin-slab maximum intensity projection, and volume rendering. Sophisticated segmentation algorithms, vessel analysis tools based on a centerline approach, and automatic lumen boundary definition are emerging techniques; bone removal with thresholding or subtraction algorithms has been introduced. ***(Lell et al., 2006).***