Otolaryngology Radiology Our road map during surgery

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Artifacts in CT imaging

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Definition:

Artifacts in CT imaging is defined as discrepancy between CT numbers in the reconstructed image viza viz the true attenuation coefficient of the object.

Note:

CT images are more prone to artifacts than conventional x-rays because the ultimate image seen is a reconstruction of more than a million parameters. These errors creep in because image reconstruction techniques presume that the measurements taken into consideration for reconstruction are consistent, which may not be true always.

Common artifacts:

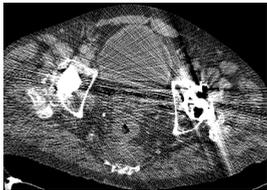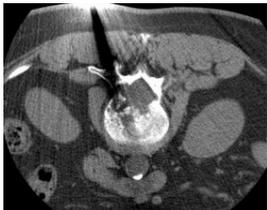1. Streaking - This artifact is caused due to inconsistency in single measurement

Figure showing streak artifact

2. Shading - This is caused due to gradual deviation of measurements of various channels from the actual.

Shading artifact seen due to missing data

3. Ring artifact - This is caused due to error in the individual detector calibration
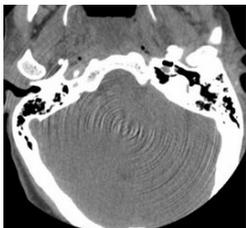

Image showing ring artifact

4. Distortion - This is caused due to hilical reconstruction

Classification of CT scan artifacts:

For the sake of convenience CT scan artifacts can be grouped under:

Physics based artifacts

Patient based artifacts

Scanner based artifacts

Multisection / Helical artifacts

Physics based artifacts:

Beam Hardening - X-ray beams used in CT imaging contains photons of varying energy ranges. When it passes through the body it hardens i.e its mean energy increases because photons with low energy are absorbed more rapidly than high energy ones. This could lead to cupping artifacts or streaking artifacts in the resultant image. Cupping artifacts are cuased because photons passing through the middle portion of the tissue hardens more when compared to those passing through the periphery. As the intensity of the beam becomes hardened its attenuation rate decreases. It reaches the sensor with minimal attenuation causing this artifact.

Imaging errors due to this hardening effects of photons can be overcome by applying relevant corrections and filtrations by the imaging software. Almost all the present day scanners have this correction system in place.

Photon starvation - This can cause streaking artifacts. This commonly occurs when high attentuating areas like shoulder is being scanned. This attenuation is maximum when the beam travels horizontally. This artifact can be overcome by increasing the duration of scan when these high attenuation areas are being scanned. This can overcome the photon starvation effect. Some of the current generation scanners have automatic tube current modulation where in the machine itself varies the tube current when high attenuation areas are being imaged.

Undersampling - The number of projections has a vital role in ensuring quality of reconstructed images. More the number of projection during the shortest span of time better becomes the reconstructed image. Stripes occuring within the scanned image is commonly due to undersampling errors.

Patient based artifacts:

Metal / implant artifacts - Presence of metallic implants can cause streak artifacts unless metal correction alogrithim is used.

Motion artifacts - Patient should be reasonably still when the imaging is being performed. A moving patient can lead to motion artifact.

Scanner based artifacts:

This commonly occurs due to calibration errors

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