Ask EuroSafe Imaging

Tips & Tricks

CT Working Group

The use of bi-phase injection protocols to reduce the number of acquisition phases and radiation dose

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Key points

- CT multiphase protocols are essential to characterise lesions in liver, renal, pancreatic and adrenal CT
- Typically 3/4 phases are acquired including acquisitions before and after administration of contrast media
- Thus increasing radiation dose significantly
- Bi-phase injection protocols allow a ‘2 or 3 in 1’ acquisition, reducing radiation dose
- The use of bi-phase injection protocols results in a reduced number of acquisitions without compromising contrast enhancement of the region of interest

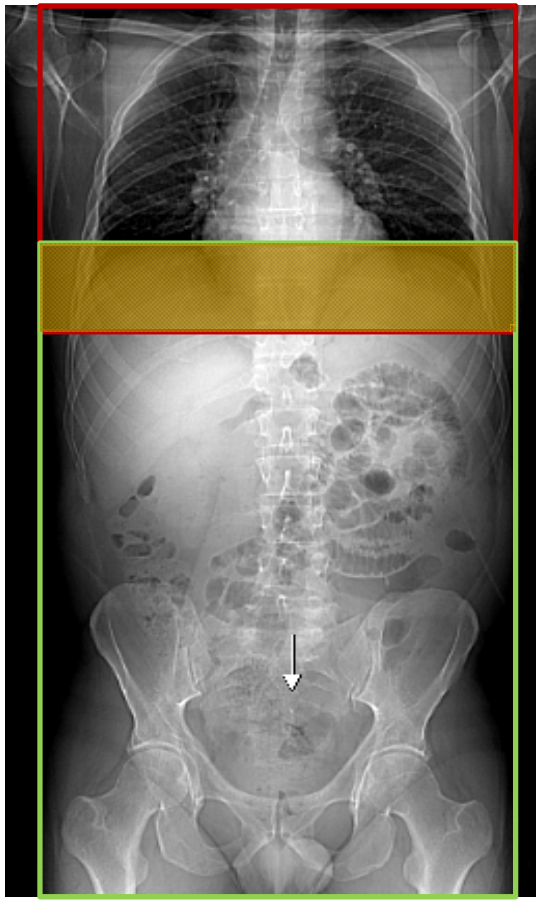
Key points

- Note bi-phase injection protocols are not recommended for all indications
- Bi-phase injection protocols involve injecting an initial bolus of contrast, waiting a predefined period of time followed by a second bolus of contrast. Acquisition is then started after a pre-defined period of time
- Bi-phase protocols can be easily stored in contrast injectors memory
- Bi-phase protocols are most frequently used in CT Thorax Abdomen Pelvis and CT Urography acquisitions
- Bi-phase protocols can be applied to liver, neck and pancreatic acquisitions
- Note bi-phase is also referred to as ‘split-bolus’ protocol

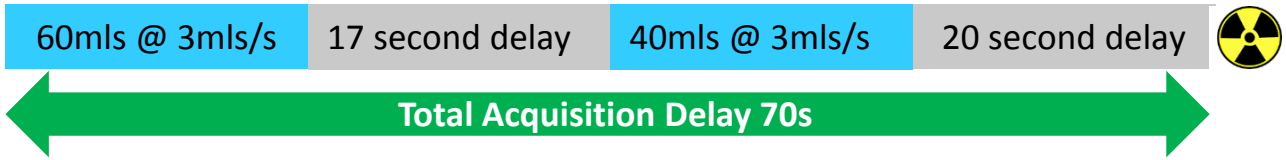
Protocols

Standard CT Thorax Abdomen Pelvis Protocol

- 80-100mls contrast IV
- Thorax acquisition @ 35s approx. post IV
- Abdomen acquisition @ 70s approx. post IV
- Significant overlap of scanned volume (shaded area on image)



Bi-phase Injection CT TAP Protocol



- Single acquisition eliminates scanned volume overlap in region of lung bases/upper liver

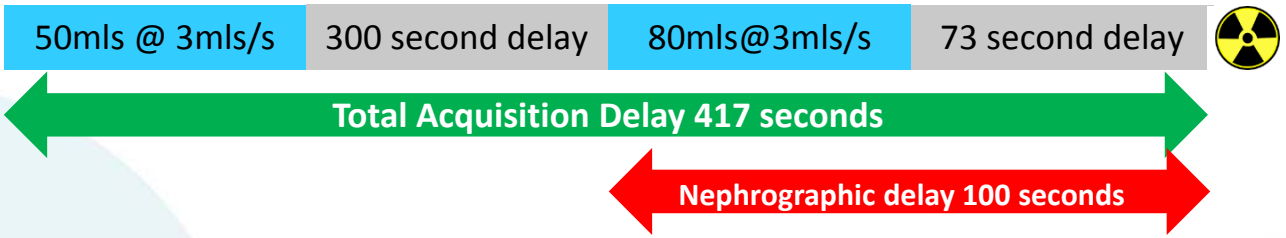
Protocols

Standard CT Urogram Protocol

- 3-phase acquisition
- Unenhanced, nephrographic, excretory

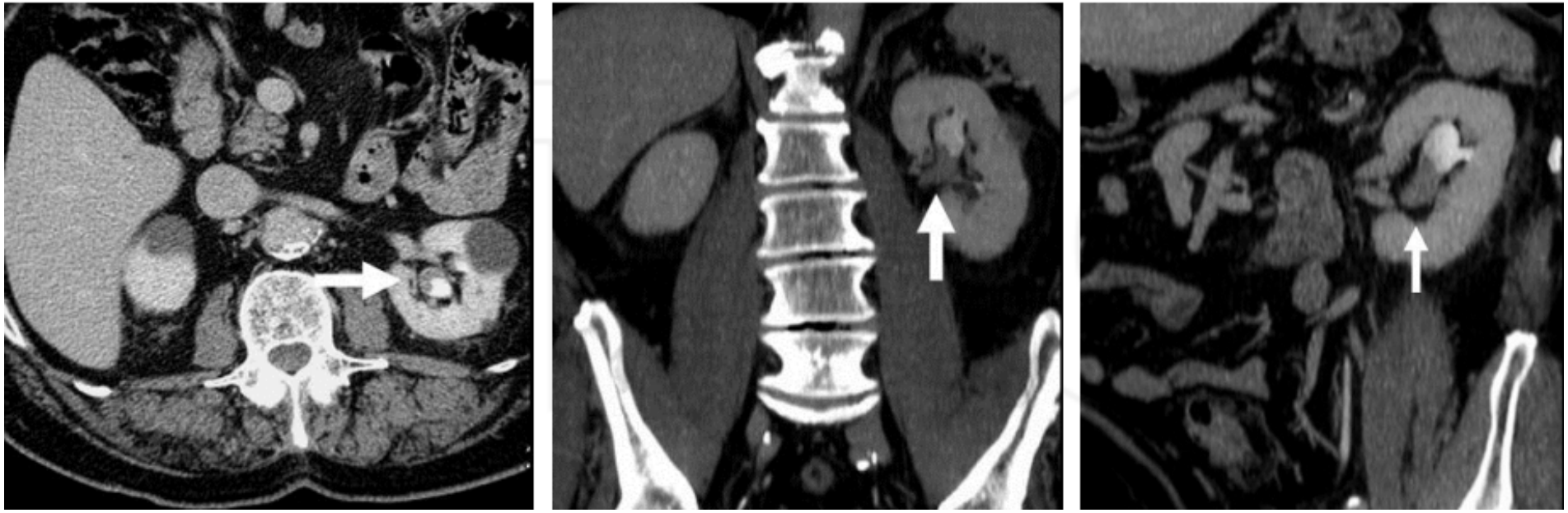
Bi-phase Injection Protocol

- Combine nephrographic and excretory phases into one acquisition
- Inject initial bolus followed by 300 second delay and then administer second bolus
- Combined phase acquisition is started following 100 seconds
- High sensitivity, specificity and accuracy for detection of upper tract tumours reported *(Maheshwari et al, 2010)*
- Up to 59% less radiation dose reported in phantom studies *(Vrtiska et al, 2009)*



(Protocol adapted from Maheshwari et al, 2010)

Protocols



Images from bi-phase CTU protocol. Contrast opacification of renal pelvis displaying TCC with simultaneous enhancement of renal parenchyma.

Images courtesy Guite, Hinshaw & Lee (2013)

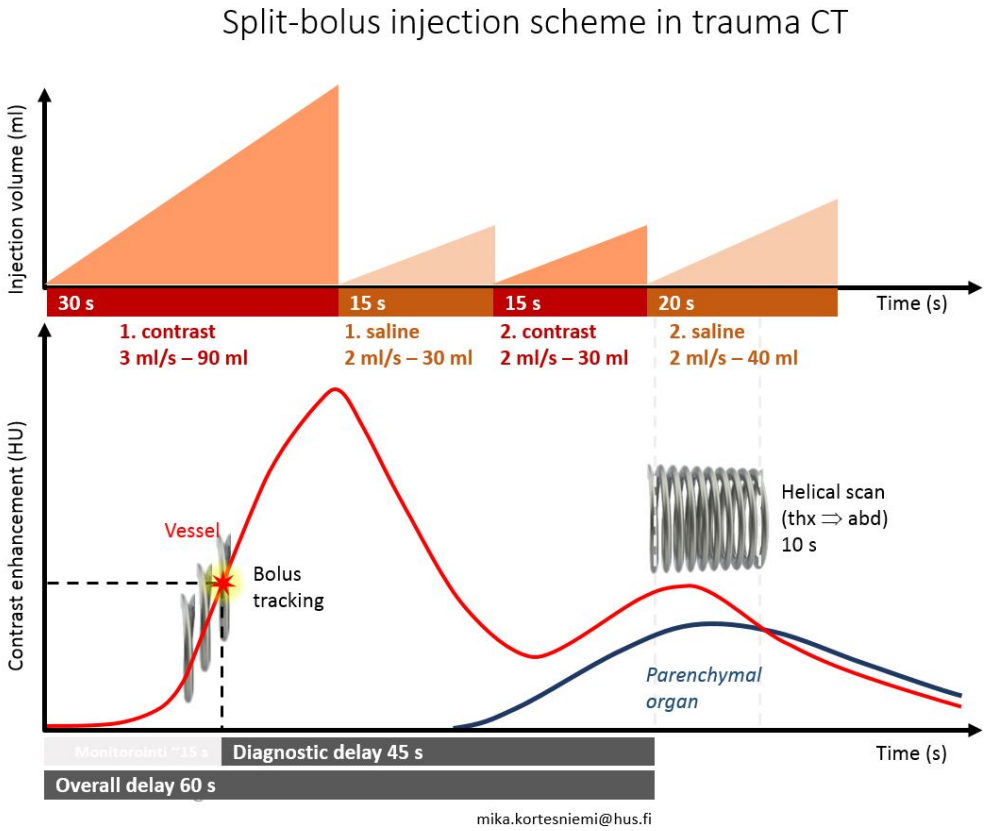
Protocols

Standard TAP trauma CT protocol

- 2-phase acquisition
- TAP arterial phase and AP venous phase

Bi-phase Injection Protocol

- Combine arterial and venous phases in one TAP acquisition



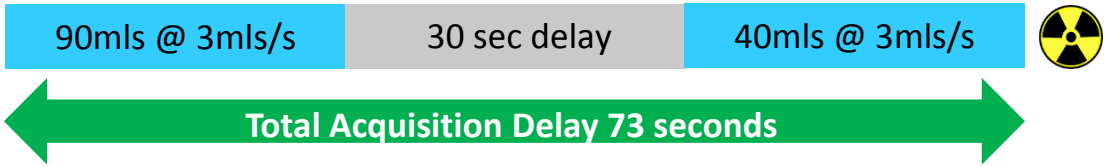
Protocols

Standard CT Pancreas Protocol

- 3-phase acquisition
- Unenhanced, pancreatic parenchymal, portal venous phases

Bi-phase Injection Protocol

- Combine pancreatic parenchymal and portal venous phases into one acquisition
- Bi-phase protocol results in vascular liver, pancreatic attenuation and tumour conspicuity equal to or greater than that with multiphase CT *(Brook et al. 2013)*
- 43% less radiation dose reported *(Brook et al. 2013)*



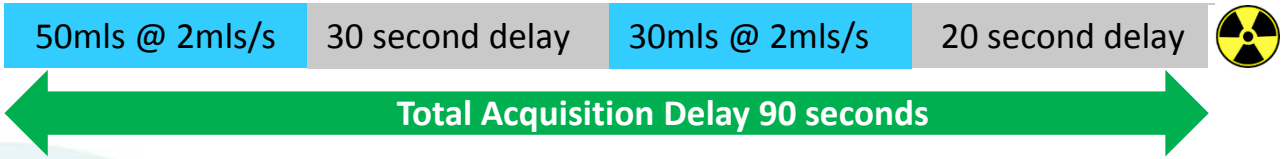
Protocols

Standard Neck CT Protocol

- 2-phase acquisition
- Vascular and delayed phases

Bi-phase Injection Protocol

- Combine vascular and delayed phases into one acquisition
- Inject initial bolus for tissue impregnation followed by second bolus for vascular opacification
- Better visualisation of neck tumour and vascular environment *(Jung-Hyung Lee et al. 2012)*



Bi-phase injection neck CT. Contrast opacification of tumour with simultaneous enhancement of vessels.

Summary

- Bi-phase/split-bolus protocols should be considered as a radiation dose reduction technique
- This protocol can be applied to routine CT TAP, CT Urography, CT neck and CT liver & pancreas
- Without compromise to diagnostic accuracy
- Contrast protocols can be easily stored in injector memory
- Significant radiation dose reduction have been reported compared with traditional multiphasic protocols

References

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