

# Ask EuroSafe Imaging Tips & Tricks

## CT Working Group

### Optimisation in automated tube voltage selection

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## Why lower kV settings?

Historically, kV was not often adjusted for the individual patient. This was partly because tube output was too low to maintain sufficient image quality at low kV.

Modern X-ray tubes, with high tube load options, opens up the possibility of lowering kV resulting in higher image contrast between tissue lesions and iodine.

Lowering kV may be an advantage depending on patient size and the diagnostic task.

Low kV is often used in paediatric CT and in contrast enhanced examinations, such as CT angiography.

## What does automated kV selection do?

Different vendors have developed systems like kV assist<sup>1</sup>, Care kV<sup>2</sup> or Sure kV and they work in conjunction with automated tube current modulation. They are similar in basic function:

- kV is selected automatically based on the scout and clinical task and then fixed
- kV may be decreased or increased dependant on patient size

However, vendors may have different approaches, emphasizing either dose or image quality.

The lowest radiation dose is not necessarily obtained with the lowest kV because the software also takes mAs, contrast-to-noise ratio and clinical task into consideration.

## What does automated kV selection do?

- Automated kV does NOT modulate kV during the scan.
- Modulating kV during the scan would result in inconsistent HU values within the individual patient, i.e. for homogeneous tissue, similar HU would be expected throughout the scan range but if kV was modulated, the HU would be different through the slices because the linear absorption coefficient would shift as a result of kV change.

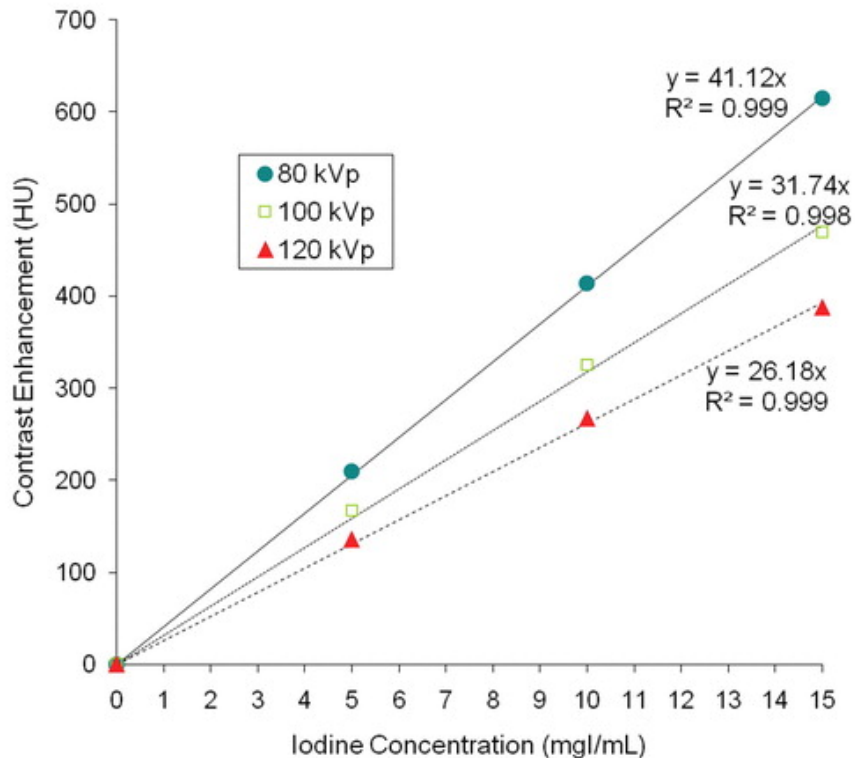
## Effects of lowering kV

Image noise will increase if mAs is not increased as kV is lowered. Lowering kV also increases contrast between iodine and tissues<sup>3</sup>. Thus, automated kV selection may result in three options:

- Maintain image noise and improve CNR
  - Beneficial if attenuation differences are small
  - However, mAs increases
- Maintain image noise and reduce amount of contrast agent
  - Beneficial when intravenous access is limited or in patients sensitive to contrast media
  - However, mAs increases
- Increase image noise and reduce radiation dose
  - Dose reduction between 30 and 38 % has been demonstrated<sup>4,5</sup>
  - Beneficial in radiation sensitive patients
  - However, image appearance may change
  - Window settings may need adjustment

# kV – Iodine concentration & enhancement

- Relationship between iodine concentration and CT enhancement at three voltage settings.



An increase in concentration by 1 mg of iodine per milliliter yields contrast enhancement of:

41.12 HU @ 80 kVp

31.74 HU @ 100 kVp

26.18 HU @ 120 kVp

The use of lower voltage results in stronger contrast enhancement per iodine concentration

Reproduced from: Bae KT, [Intravenous Contrast Medium Administration and Scan Timing at CT: Considerations and Approaches](#) Radiology, 2010 256:1, 32-61

## Always consider

- Lowering kV may result in different image appearance as with all automatic exposure systems. Therefore, be careful of objects in topogram such as shielding, wires etc.
- Lowering kV will affect HU values and therefore, automated kV selection should be used with caution if HU values are used to guide clinical decisions.
- Window-Width and Window-Level may need adjustment.
- Lowest dose is not necessarily obtained with the lowest kV.
- Check the estimated  $CTDI_{vol}$  displayed in the scanner console before scanning to check if radiation dose is acceptable.

## References

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5. Yang B, Li Z-L, Gao Y, Yang Y-Y, Zhao W. Image quality evaluation for CARE kV technique combined with iterative reconstruction for chest computed tomography scanning. *Medicine*. 2017;96(11):e6175-e.
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