



ORIGINAL ARTICLE

Comparison of image quality and radiation dose in computed tomography angiography of the peripheral arteries using tube voltage of 80 kV versus 100 kV[☆]

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KEYWORDS

Peripheral arterial disease;
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Abstract

Objective: To compare the image quality and dose of radiation in two groups of patients undergoing CT angiography of the lower limbs, one with tube voltage of 80 kV and the other with tube voltage of 100 kV.

Materials and methods: We performed CT angiography of the lower limbs in 60 patients with suspected peripheral arterial disease. Patients were randomly assigned to one of the two groups; in one group, CT angiography was performed using a tube voltage of 80 kV, whereas in the other it was performed using 100 kV. The remaining acquisition parameters were the same in both groups. The images were analyzed by quantifying vascular density (VD) and noise (N) and by calculating the quotients density/noise (QVDN) and contrast/noise (QCN). Two radiologists working independently evaluated the subjective quality of the images. We calculated the estimated effective dose (EED) based on the dose-length product (DLP).

Results: In the group studied at 80 kV, VD was significantly higher ($462.5 \text{ UH} \pm 95.6$ vs $372 \text{ UH} \pm 100.9$; $P < .001$), QVDN was significantly higher (241.9 ± 48.1 vs 194.3 ± 49.6 ; $P < .001$), and there were trends toward higher N ($21.3 \text{ UH} \pm 13$ vs $16.3 \text{ UH} \pm 3.5$; $P = .098$) and toward higher QCN (21.4 ± 12.1 vs 22.9 ± 9.1 ; $P = .15$). No significant differences were found in the subjective quality of the images. The EED was significantly lower in the group studied at 80 kV ($4.73 \text{ mSv} \pm 1.1$ vs $9.6 \text{ mSv} \pm 2.2$; $P < .001$).

Conclusion: Using 80 kV instead of 100 kV for CT angiography of the lower limbs reduces the dose of radiation without affecting the diagnostic efficacy of the study.

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PALABRAS CLAVE

Enfermedad arterial
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Tomografía
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Dosis de radiación

Comparación de la calidad de imagen y dosis de radiación en angio-tomografía computarizada de arterias periféricas con 80 y 100 kV

Resumen

Objetivo: Comparar la calidad de imagen y la dosis de radiación en 2 grupos de pacientes a los que se realiza angio-TC de extremidades inferiores con 80 y 100 kV.

Material y métodos: Se realizó angio-TC de miembros inferiores a 60 pacientes con sospecha de enfermedad arterial periférica aleatorizados en 2 grupos, en uno la TC se realizó con 80 kV y en el otro con 100 kV. Los demás parámetros de adquisición se mantuvieron constantes. Se analizaron las imágenes cuantificando la densidad vascular (DV) y el ruido (R), y se calcularon los cocientes densidad vascular/ruido (CDVR) y contraste/ruido (CCR). Dos radiólogos evaluaron independientemente la calidad subjetiva de las imágenes. Se calculó la dosis efectiva estimada (DEE) basada en el producto dosis-longitud (DLP).

Resultados: El grupo de 80 kV presentó valores significativamente más elevados de la DV ($462,5 \text{ UH} \pm 95,6$ vs. $372 \text{ UH} \pm 100,9$; $p < 0,001$) y del CDVR ($241,9 \pm 48,1$ vs. $194,3 \pm 49,6$; $p < 0,001$) y diferencias no significativas del R ($21,3 \text{ UH} \pm 13$ vs. $16,3 \text{ UH} \pm 3,5$; $p = 0,098$) y el CCR ($21,4 \pm 12,1$ vs. $22,9 \pm 9,1$; $p = 0,15$). No hubo diferencias significativas en la calidad subjetiva de la imagen y la dosis efectiva fue significativamente menor en el grupo de 80 kV ($4,73 \text{ mSv} \pm 1,1$ vs. $9,6 \text{ mSv} \pm 2,2$; $p < 0,001$).

Conclusión: La utilización de 80 kV en el estudio de angio-TC de miembros inferiores disminuye la dosis de radiación sin afectar a la eficacia diagnóstica del estudio respecto a la utilización de 100 kV.

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Introduction

Peripheral artery disease (PAD) whose etiopathological factor is arterosclerosis is a serious health condition. Its prevalence is high: it affects 12% of adult population and 20% of people <70 years old.^{1,2} Its diagnosis is based on clinical criteria and image modalities that help us plan the appropriate therapy. Traditionally the assessment of pretreatment has been performed through conventional angiographies yet this modality is not free from complications.³ Angio-CT has proven to be an efficient exploratory tool to diagnose PAD in lower limbs. Several studies confirm the high diagnostic security of this modality when exploring the peripheral arterial system as easier less bloody more widely available test than digital angiography. For all these reasons angio-CT is more and more used to diagnose PAD while accounting for 5% of all planned explorations and 0.1% of scanning emergencies.⁴⁻¹²

Recently it has been proven that 64-detector row angio-CT equals conventional angiography both for the diagnosis and planning of therapy in patients with PAD.¹³ Yet angio-CT has several drawbacks like its poor diagnostic capacity when in the presence of calcification, its low profitability in stenoses <50% and above all due its radiation dose up to 12–13 mSv due to large anatomical volumes included and acquisitions that performed through thinner cuts.¹⁴ The idea of reducing the radiation dose of CT up to reasonable limits still stands today.^{15,16} There are studies on other vascular territories showing that it is possible to reduce the dose of radiation with protocols of fewer kV without affecting the quality of the diagnostic images acquired¹⁷ yet there are few studies showing how to optimize the radiation dose when studying lower limbs through angio-CT¹⁸—none of them just by reducing kV. Reducing kV not only reduces the radiation dose but also increases vascular enhancement.

This is due to the fact that the level of maximum iodine attenuation (K-edge) is 33 kV, i.e. with energies of 80 kV the attenuation is >100 kV.^{19,20}

Hence our goal is to check if there are differences in the diagnostic quality of angio-CT of lower limbs and in radiation dose while reducing kV.

Materials and methods**Patients**

We did a prospective observational study where 60 randomized patients in two (2) groups during a period of five (5) months were analyzed. The study was approved by the hospital ethical committee and all patients signed prior written informed consent.

The criterion to do the test was the request of one angio-CT of lower limbs due to suspicion of acute or chronic peripheral artery disease. Exclusion criteria were contrast allergies, pregnancy, hyperthyroidism or renal failure (glomerular filtration rate below 35 ml/min/m^2), age <18 years old and not signing the aforementioned informed consent. Patients were randomized in two (2) groups through a computed generated list with the program Excel[®] 2007 (Microsoft[®]) that randomly assigned kilovoltage to every patient. In group A the 100 kV protocol was used and in group B the 80 kV protocol was used. In group A 32 males and 7 women of an average 65.9 ± 16.5 years of age were included. In group B 23 males and 7 women of an average 65.8 ± 12.6 years of age were included.

Computed angio-tomography of lower limbs

All studies were done through a 64-detector row angio-CT (Somatom Sensation 64[®]; Siemens Medical Systems,

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