



ORIGINAL ARTICLE

## Effective radiation dose of three diagnostic tests in cardiology: Single photon emission computed tomography, invasive coronary angiography and cardiac computed tomography angiography



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### KEYWORDS

Ionizing radiation;  
Single photon emission computed tomography;  
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Cardiac computed tomography;  
Obesity

### Abstract

**Introduction:** Diagnostic tests that use ionizing radiation play a central role in cardiology and their use has grown in recent years, leading to increasing concerns about their potential stochastic effects.

The aims of this study were to compare the radiation dose of three diagnostic tests: single photon emission computed tomography (SPECT), invasive coronary angiography (ICA) and cardiac computed tomography (cardiac CT) and their evolution over time, and to assess the influence of body mass index on radiation dose.

**Methods:** We assessed consecutive patients included in three prospective registries (SPECT, ICA and cardiac CT) over a period of two years. Radiation dose was converted to mSv and compared between the three registries. Differences over time were evaluated by comparing the first with the fourth semester.

**Results:** A total of 6196 exams were evaluated: 35% SPECT, 53% ICA and 22% cardiac CT. Mean radiation dose was  $10.7 \pm 1.2$  mSv for SPECT,  $8.1 \pm 6.4$  mSv for ICA, and  $5.4 \pm 3.8$  mSv for cardiac CT ( $p < 0.001$  for all). With regard to the radiation dose over time, there was a very small

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**PALAVRAS-CHAVE**

Radiação;  
Cintigrafia de  
perfusão miocárdica;  
Coronariografia  
invasiva;  
Tomografia  
computorizada  
cardíaca;  
Obesidade

reduction in SPECT (10.7 to 10.5 mSv,  $p=0.004$ ), a significant increase (25%) in ICA (7.0 to 8.8 mSv;  $p<0.001$ ), and a significant reduction (29%) in cardiac CT (6.5 to 4.6 mSv,  $p<0.001$ ). Obesity was associated with a significantly higher radiation dose in all three exams.

**Conclusions:** Cardiac CT had a lower mean effective radiation dose than invasive coronary angiography, which in turn had a lower mean effective dose than SPECT.

There was a significant increase in radiation doses in the ICA registry and a significant decrease in the cardiac CT registry over time.

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### Dose efetiva de radiação de três exames de diagnóstico em cardiologia: cintigrafia de perfusão miocárdica, coronariografia invasiva e tomografia computadorizada cardíaca

**Resumo**

**Introdução:** Os exames diagnósticos que usam radiação ionizante têm um papel central na cardiologia e a par do seu uso crescente, tem aumentado a preocupação pelos seus potenciais efeitos estocásticos.

Os objetivos deste estudo foram: 1) Comparar a dose de radiação de três exames: Cintigrafia de perfusão miocárdica (SPECT), coronariografia invasiva (CAT) e tomografia computadorizada cardíaca (AngioTC) e a sua evolução temporal. 2) Avaliar o impacto do índice de massa corporal na dose de radiação.

**Métodos:** Doentes consecutivos incluídos em três registos prospetivos (SPECT, CAT e AngioTC) durante dois anos. A dose de radiação foi convertida a mSv e comparada entre os três registos. A evolução temporal foi avaliada por comparação do 1.º e 4.º semestres.

**Resultados:** Foram avaliados 6196 exames: 35% SPECT, 53% CAT e 22% AngioTC. A dose de radiação foi:  $10,7 \pm 1,2$  mSv para o SPECT;  $8,1 \pm 6,4$  mSv para o CAT;  $5,4 \pm 3,8$  mSv para a AngioTC ( $p < 0,001$  todas comparações).

Evolução temporal da dose de radiação: redução muito ligeira no SPECT (10,7 para 10,5 mSv;  $p = 0,004$ ); aumento significativo (25%) no CAT (7,0 para 8,8 mSv;  $p < 0,001$ ); redução significativa (29%) na AngioTC (6,5 para 4,6 mSv;  $p < 0,001$ ). A obesidade associou-se a níveis de radiação significativamente mais elevados nos três exames.

**Conclusão:** O exame associado a uma menor dose de radiação foi a AngioTC, seguida do CAT que, por sua vez, foi menor que a do SPECT. Houve um aumento significativo da dose de radiação no registo CAT e uma redução significativa no registo da AngioTC ao longo do tempo.

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**List of abbreviations**

BMI	Body mass index
CAD	coronary artery disease
CT	computed tomography
ICA	invasive coronary angiography
SPECT	single photon emission computed tomography

**Introduction**

In recent years, the development of imaging techniques using ionizing radiation has resulted in considerable progress in the diagnosis and treatment of heart disease. Three commonly used diagnostic modalities that involve ionizing radiation are used for assessing patients with possible coronary artery disease (CAD): single photon emission computed tomography (SPECT), cardiac computed tomography

(cardiac CT) and invasive coronary angiography (ICA), the latter being considered the gold standard for the diagnosis of CAD.<sup>1</sup>

Different radiation doses have been reported for each of these exams, ranging from 5 to 10 mSv for ICA, 6 to 15 mSv for SPECT, and 4 to 21 mSv for cardiac CT.<sup>2-5</sup> With more frequent use of these exams, there have been growing concerns about the radiation's potential secondary effects, especially the stochastic effects of high cumulative doses over time.<sup>6,7</sup>

We have previously reported on the effective radiation dose associated with cardiac CT in a single-center registry, documenting a significant decrease in dose over time, and were able to identify the predictors of higher dose.<sup>8</sup>

New scanners and acquisition protocols have recently been developed which lead to significant reductions in radiation dose associated with cardiac CT.<sup>9,10</sup>

The aims of this study were to evaluate and compare the radiation dose used in three diagnostic tests – SPECT, ICA and cardiac CT – and their evolution over time, and to assess the influence of body mass index on radiation dose.

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