

temporal resolution and reduced radiation doses, these developments include the introduction of complementary explorations for the detection of ischemia (perfusion, noninvasive determination of functional repercussion of stenosis, etc.). These advances have made MDCT one of the most sensitive and specific methods for ruling out significant coronary artery disease, second only to invasive coronary angiography. The noninvasive nature of MDCT moreover brings added benefits, including the detection of subclinical coronary artery disease,² the potential to characterize high-risk plaques, and prognostic value.

2. Technical considerations. The diagnostic performance of MDCT could have been improved with an optimized spatial resolution of the reconstructions, achievable by modifying the slice thickness, the between-slice increase and filters as described by other authors³ working with exactly the same type of scanner. Additionally, given the mean body surface area observed in the study population (although the benchmark parameter in cardiac CT is body-mass index), a tube potential of 100 kV would have improved luminal contrast in the coronary arteries, thereby facilitating image interpretation and exponentially reduces the radiation dose. Such dose reductions are line with Society of Cardiovascular Computed Tomography guidelines, which recommend the establishment of quality assurance procedures to meet the following objectives: sufficient diagnostic quality in $\geq 95\%$ of scans, a demonstrable diagnostic accuracy at least 75% that of invasive coronary angiography, and a mean radiation dose at the reference level (12 mSv according to the most recent guidelines).⁴ Today, with a careful acquisition protocol and the latest scanners, doses are normally in the region of 1–2 mSv or even lower, well below the 7–10 mSv in invasive coronary angiography and the 8–10 mSv in isotope studies with gamma radiation, demonstrated to be more harmful than X rays.
3. Methodological considerations. An Agatston score > 400 is not equivalent to the detection of significant coronary artery disease by MDCT because this threshold drags down the specificity of the method, with 20% of patients with this score having no disease.⁵ The authors' statement in the Discussion that "MDCT has low diagnostic specificity" seems to me to be inappropriate. What limits specificity is setting the significance threshold at $\geq 50\%$ when the "reference pattern" is $\geq 70\%$ for invasive coronary angiography (luminogram) and MDCT is based on this same "luminogram", with the advantage of assessing the coronary wall. The $\geq 50\%$ significance threshold was established

in the cited study by Hoffmann, in which final cost-effectiveness did not reach statistical significance. In contrast, the Goldstein study, using a significance threshold of $\geq 70\%$, showed a significantly positive cost-effectiveness for MDCT (\$2137 for MDCT compared with \$3458 for standard; $P < .0001$).

The major scientific societies now accept the diagnostic value of both techniques and their complementary nature, especially in non-diagnostic MDCT studies and studies that indirectly evaluate the functional repercussion of intermediate or limiting stenosis, an evaluation achieved directly with pressure guides in invasive coronary angiography.

Paz Catalán-Sanz

Certificación en la Subespecialidad de Tomografía Computarizada Cardiovascular (CBCCT); Cardiovascular Healthcare Innovation, Madrid, Spain

E-mail address: pazcatalan@secardiologia.es

Available online 15 December 2014

REFERENCES

1. Mas-Stachurska A, Miró O, Sitges M, de Caralt TM, Perea RJ, López B, et al. Evaluación del dolor torácico agudo mediante ecocardiografía de ejercicio y tomografía computarizada multidetector. Rev Esp Cardiol. 2014. <http://dx.doi.org/10.1016/j.recesp.2014.05.009>
2. Descalzo M, Leta R, Rosselló X, Alomar X, Carreras F, Pons-Lladó G. Enfermedad coronaria subclínica por tomografía computarizada multidetector en población asintomática estratificada por nivel de riesgo coronario. Rev Esp Cardiol. 2013;66:504–5.
3. Rixe J, Achenbach S, Ropers D, Baum U, Kuettner A, Ropers U, et al. Assessment of coronary artery stent restenosis by 64-slice multi-detector computed tomography. Eur Heart J. 2006;27:2567–72.
4. Halliburton SS, Abbata S, Chen MY, Gentry R, Mahesh M, Raff GL, et al.; Society of Cardiovascular Computed Tomography. SCCT guidelines on radiation dose and dose-optimization strategies in cardiovascular CT. J Cardiovasc Comput Tomogr. 2011;5:198–224.
5. Von Ziegler F, Schenzle J, Schiessl S, Greif M, Helbig S, Tittus J, et al. Use of multi-slice computed tomography in patients with chest-pain submitted to the emergency department. Int J Cardiovasc Imaging. 2014;30:145–53.

SEE RELATED ARTICLES:

<http://dx.doi.org/10.1016/j.rec.2014.10.004>

<http://dx.doi.org/10.1016/j.rec.2014.05.009>

<http://dx.doi.org/10.1016/j.rec.2014.09.014>

Comments on Exercise Echocardiography and Multidetector Computed Tomography for the Evaluation of Acute Chest Pain. Response



Comentarios a la evaluación del dolor torácico agudo mediante ecocardiografía de ejercicio y tomografía computarizada multidetectores. Respuesta

To the Editor,

We would like to thank Dr Catalán for her comments and to clarify certain points.

Although major technological progress has been made in cardiac multidetector computed tomography (MDCT) since 2008 when the above-mentioned study was started, it is important to recognize that both the myocardial perfusion study and the recent evaluation of functional repercussion using MDCT discussed by Dr Catalán are emerging techniques that are not included in

clinical practice guidelines.¹ Noninvasive estimation of the coronary reserve flow using MDCT, whose analysis is still not widely available, could be promising in the future, but its diagnostic value in addition to MDCT angiography is still to be determined for acute chest pain.

Dr Catalán states that the results could have been improved by a different image reconstruction according to the study by Rixe et al.² The device used in our study provides a rotation time of 370 ms, inferior to the 330 ms used by Rixe et al. To compensate for the loss of sharpness of the coronary lumen, we used 0.7 mm slices and 0.4 mm increments instead of the 0.6×0.3 mm suggested by Rixe et al, resulting from the tests performed and consensus among 3 observers. For the same reasons, a tube current of 120 kV was maintained, similar to that used by Rixe et al, instead of the suggested 100 kV.

Our article acknowledges the specificity of MDCT was affected by the 50% stenosis cut-off value, which is why we conducted another analysis at 70%, producing a considerable improvement in

specificity. However, we did not think that an Agatston Ca score > 400 significantly impaired the specificity of MDCT, as only 1 in 5 patients with a Ca score > 400 did not show acute coronary syndrome. With similar devices, in the presence of a Ca score > 400, the proportion of nonconclusive studies increases, luminal stenosis is overestimated and the specificity of the technique is severely limited³; moreover, a Ca score of > 400 has been shown to be an excellent predictor for significant coronary disease.⁴ Along the same lines, Goldstein et al⁵ recommended performing single-photon emission computed tomography (SPECT) when Ca scores were > 100, markedly lower than the 400 score used in our study.

Finally, in our opinion, the cost-effectiveness differences between the studies by Hoffman et al⁶ and Goldstein et al⁵ were not exclusively due to the differences in the cut-off values chosen for stenosis (50% vs 70%). Moreover, there were differences in the prevalence of acute coronary syndrome in the MDCT group (9% vs 4.4%), as well as large differences in the percentage of additional tests conducted in the control groups of the 2 studies (45% vs 100%, respectively), which contributed to the discrepancies observed.

José T. Ortiz-Pérez* and Xavier Bosch

Servicio de Cardiología, Instituto Clínico del Tórax, Hospital Clínic, IDIBAPS, Universidad de Barcelona, Barcelona, Spain

*Corresponding author:

E-mail address: jtortiz@clinic.ub.es (J.T. Ortiz-Pérez).

Available online 23 December 2014

REFERENCES

1. Raff GL, Chinnaiyan KM, Cury RC, Garcia MT, Hecht HS, Hollander JE, et al. SCCT guidelines on the use of coronary computed tomographic angiography for patients presenting with acute chest pain to the emergency department: A report of the society of cardiovascular computed tomography guidelines committee. *J Cardiovasc Comput Tomogr*. 2014;8:254–71.
2. Rixe J, Achenbach S, Ropers D, Baum U, Kuettner A, Ropers U, et al. Assessment of coronary artery stent restenosis by 64-slice multi-detector computed tomography. *Eur Heart J*. 2006;27:2567–72.
3. Abdulla J, Pedersen KS, Budoff M, Kofoed KF. Influence of coronary calcification on the diagnostic accuracy of 64-slice computed tomography coronary angiography: A systematic review and meta-analysis. *Int J Cardiovasc Imaging*. 2012;28:943–53.
4. de Agustín JA, Marcos-Alberca P, Fernández-Golfín C, Feltes G, Nunez-Gil IJ, Almería C, et al. Should computed tomography coronary angiography be aborted when the calcium score exceeds a certain threshold in patients with chest pain? *Int J Cardiol*. 2013;167:2013–7.
5. Goldstein JA, Chinnaiyan KM, Abidov A, Achenbach S, Berman DS, Hayes SW, et al. The CT-STAT (coronary computed tomographic angiography for systematic triage of acute chest pain patients to treatment) trial. *J Am Coll Cardiol*. 2011;58:1414–22.
6. Hoffmann U, Truong QA, Schoenfeld DA, Chou ET, Woodard PK, Nagurney JT, et al. Coronary CT angiography versus standard evaluation in acute chest pain. *N Engl J Med*. 2012;367:299–308.

SEE RELATED ARTICLE:

<http://dx.doi.org/10.1016/j.rec.2014.09.014>

<http://dx.doi.org/10.1016/j.rec.2014.10.004>

The Genetic Background of Left Ventricular Hypertrabeculation / Noncompaction Remains Vague



El trasfondo genético de la hipertrabeculación/miocardiopatía no compactada ventricular izquierda sigue sin estar claro

To the Editor,

We read with interest the article by Rodríguez-Serrano et al¹ about familial left ventricular hypertrabeculation/noncompaction (LVHT) associated with a novel alpha-cardiac actin gene (*ACTC1*)-mutation in 4 family members (II:4, III:4, III:6, IV:1), of whom 3 (II:4, III:4, III:6) presented with noncompaction and 1 with hypertrabeculation of the explanted heart. We have the following comments and concerns.

We do not agree with the statement that the described *ACTC1*-mutation “caused” LVHT.¹ LVHT is associated with mutations in a large number of different genes but no proof has ever been provided for any of these associations that a particular mutation is truly causative of this myocardial abnormality. Reservations against a causal relation comes from the following arguments: first, in most cases of hereditary disease in which LVHT has been described, only a limited number of mutation carriers also had LVHT.² Second, LVHT may be a dynamic abnormality that may not be present at birth in single patients (acquired LVHT)³ and may more rarely even disappear during life.⁴ Third, most of the few patients with acquired LVHT did not carry a mutated gene and did not have LVHT on previous echocardiographic or other cardiac imaging studies.⁵ Fourth, according to the authors themselves, the pathogenicity of the detected *ACTC1* variant was neither confirmed nor excluded by

in silico analysis.¹ Fifth, the mutated genes so far associated with LVHT are responsible for a variety of hereditary disorders, ranging from cardiac to neuromuscular disease, including hereditary neuropathies and cobalamin-C deficiency.⁴ Sixth, LVHT frequently occurs in patients with chromosomal defects (eg, p1.36 syndrome).² Given these arguments, we consider LVHT to be a secondary myocardial abnormality in compensation for other cardiac disease, possibly induced by upregulation of regulatory genes.

Concerning the index patient, some confusion derives from the description of the explanted heart as having shown LVHT but this is not mentioned in the pedigree. Instead, the authors describe the patient as having “left ventricular hypertrabeculation”. What is the difference between noncompaction and left ventricular hypertrabeculation? In our understanding, noncompaction and hypertrabeculation are 2 different terms for the same entity.⁶ The term hypertrabeculation, however, appears to be the more favorable one since it is descriptive and does not imply a causal relation.

Since there is no general agreement on the definition of LVHT, it would be interesting to know if LVHT in the 4 individuals presented would meet Chin’s or Stöllberger’s diagnostic criteria.

The echocardiographic image of patient IV:1 is not convincing. Why was LVHT absent on echocardiography? Were the cine loops of this investigation revised? Was LVHT truly absent? If truly absent, what was the reason for the discrepancy with the histologic finding in the explanted heart? Since it is mentioned that this patient had undergone heart transplantation, a picture of the explanted heart would be helpful.

Although involvement of the skeletal muscle in *ACTC1*-mutations has not been reported, it is advisable to investigate all individuals with LVHT neurologically. This is because neuromuscular disorders