Coronary Computed Tomography Angiography-Derived Fractional Flow Reserve Assessment: Many Roads to Reach the Same Goal

To the Editor:

With great interest, our research group read the review by Otake et al published in the Circulation Journal, where the authors summarized the scientific basis and clinical trials of noninvasive computed tomography-based fractional flow reserve (CT-FFR). 1

As a novel concept, CT-FFR has been demonstrated to significantly improve the diagnostic performance of coronary computed tomography (cCTA) alone. These results were validated by invasive fractional flow reserve (FFR) and led to approval by the US Food and Drug Administration in 2014. Nonetheless, the authors of the present article correctly remarked that the future avenues of this concept are still unclear and subject to further debate.

The clinical utility and the gatekeeper function of this innovative approach underlie several limitations, such as predefined image quality and severe calcification of coronary vessels. Currently, utility is limited because of the time consuming (±1–4h) off-site calculation with the need for data transfer to external core laboratories using supercomputational power.

Therefore, a smart solution for real-time CT-FFR derivation using regular on-site workstations was developed to elegantly avoid this limitation. We recognized that the first initial study results by both Coenen et al 2 and our research group 3 were not included in the aforementioned review. 1 Both studies used the same software prototype and showed a moderate to good Pearson correlation between CT-FFR and FFR (r=0.59 and r=0.66). Moreover, a marked improvement of specificity (65% vs. 38% and 85% vs. 34%, respectively) and of positive predictive value (65% vs. 38% and 85% vs. 34%, respectively) and of positive predictive value (65% vs. 38% and 85% vs. 34%, respectively) over anatomical cCTA assessment focusing on stenosis ≥50% was noted. Another important aspect was, that the mean total time for CT-based FFR in our population was only 37.5±13.8 min/patient.

A working group from Australia recently published an article on another reduced-order fluid model and demonstrated that this method is also feasible, fast (27.1±7.5 min) and robust. CT-FFR resulted in an incremental diagnostic value with higher specificity (87% vs. 74%) and positive predictive value (74% vs. 60%), when compared with cCTA using FFR as the reference standard. 4

The most recent CT-FFR algorithm (not commercially available) applies fluid dynamics and artificial intelligence deep machine learning reduced-order models for more expeditious calculation. Even though prospective multicenter data are missing at the present time, a large registry from 5 worldwide centers (MACHINE, Machine learning Based CT angiographHy derived FFR: a MulticetNtE registry, NCT02805621) is currently ongoing with an estimated enrollment of 352 patients and 525 vessels.

In our opinion it would strengthen the review to add the 3 studies mentioned and to discuss the different approaches with their respective strengths and limitations of CT-FFR calculation. Even though the physician-driven technique seems more practical for routine clinical practice, some important steps, such as real-world data and proof of safety at clinical follow-up, are required before the reduced-order models can be implemented into clinical use.

Concluding our comment, we would like to congratulate the authors for their excellent review, as it covers a highly topical as well as frequent subject of discussion that will likely be of great interest to readers.

Conflict of Interest

All other authors declare that they have no financial disclosures.

References


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