Physiological guided percutaneous coronary intervention (PCI) has been demonstrated to result in a better clinical outcome compared with angiographic guidance alone. Pressure and Doppler-tipped guide wires that can be used for intracoronary physiological assessment were introduced >2 decades ago. Fractional flow reserve (FFR) has emerged as the most widely used physiological index in current clinical practice. This pressure-only index estimates the functional significance of a coronary stenosis by quantifying the trans-stenotic pressure ratio under hyperemic conditions and has been well validated throughout the years. However, the prerequisite of inducing stable hyperemia is considered the main practical limitation of FFR measurements that has hampered its embedding in clinical practice.

The present study shows that a pressure wire drift of ±2 mm Hg causes stenosis misclassification in all contemporary-used pressure-derived indices, in particular when close to the cutoff value. The effect of drift originating from changes in distal pressure resulted in reclassification in 21%, 25%, and 33% with FFR, iFR, and whole-cycle Pd/Pa, respectively. Both FFR and iFR had significantly lower proportions of misclassification than Pd/Pa. The effect of pressure drift originating from aortic pressure drift yielded similar results. FFR and iFR are reported to be less susceptible to drift than whole-cycle Pd/Pa. The authors further conclude that measurements need to be repeated when drift exceeds ±2 mm Hg.

The present study is the first to assess the impact of drift on stenosis misclassification in a systematic way. The authors address a relevant and important topic of the influence of pressure drift of the sensor-equipped guide wires on the assessment and classification of functional stenosis severity by pressure-only-derived indices. The present study is of particular interest in an era where physiological stenosis severity assessment is shifting toward nonhyperemic indices. Several thresholds for pressure drift are proposed and used in core laboratory analyses. Core laboratories apply a threshold of ±2 mm Hg, although the present study shows that it already causes severe reclassification. Unfortunately, data on the influence of pressure drift on physiological indices are lacking, and the present study provides valuable insight into a phenomenon frequently encountered by those performing these physiological measurements in clinical practice.
The pressure wire is not always the source of error. Pressure drift can originate from many other sources as presented by Cook et al in Table 1 of their article. Cook et al performed their measurements in a robust methodological fashion, thereby eliminating the likelihood of drift induced on the aortic pressure signal and mainly focused on the drift originating from the pressure wire. However, it is this drift on the aortic pressure signal that, because of procedural errors, should be considered the main source of the observed drift. In particular, the alteration of the pressure transducer height after normalization and not removing the needle guidewire introducer are frequently encountered errors during physiological assessment that affect the aortic pressure signal. With the introduction of nonfixed aortic pressure transducers lying loosely on top of the patient, shifting the transducer by only 3 cm in height, a pressure drift as high as 2 mm Hg is induced originating from the aortic pressure rather than from the pressure wire sensor. However, these rather small procedural errors are often not noticed.

Pressure drift is often depicted as the absolute difference between aortic and distal pressure but can also be assessed as a ratio. The impact of absolute pressure drift on stenosis reclassification may differ depending on the absolute values of mean aortic pressure. For example, in a patient with a mean arterial pressure of 120 mm Hg, the relative influence of a pressure drift of 5 mm Hg, according to the expert consensus, is less than that of a patient with a mean arterial pressure of 90 mm Hg. This effect is of particular interest when hyperemia is induced by means of continuous administration of intravenous adenosine, where often a pronounced decrease in arterial pressure is observed due to systemic vasodilation. It could be postulated that assessing the relative pressure drift is preferred to assessing an absolute drift to accommodate the relative impact of drift on the physiological measurements depending on the mean arterial pressure.

Despite the fact that the ±2 mm Hg threshold for clinically accepted drift is used in core laboratory analyses of numerous studies, the threshold for drift itself has never been a subject of extensive research. The proposed thresholds of clinically acceptable drift range widely. The present study underscores the importance of adhering to the stringent threshold also used in core laboratory analysis. This is of particular importance when the indices are close to the cutoff value, ±0.05 U of their cutoff value, in which the authors report that for iFR and whole-cycle PD/Pa reclassification occurred in 50.1% and 62.1%, respectively. This indicates that drift cannot be tolerated using nonhyperemic indices that are close to the cutoff value and the ±2 mm Hg might already be too liberal. On the contrary, when values are far away from their cutoff value, drift is unlikely to result in stenosis misclassification.

Evidence for the usefulness of nonhyperemic indices, such as iFR and whole-cycle PD/Pa, for the assessment of physiological stenosis severity is accumulating. It is conceivable that these indices, because of their ease of use, will be more frequently applied in daily clinical practice. However, the use of resting indices for the evaluation of coronary stenosis severity is not always as simple as it seems. They are more vulnerable for drift, resulting in a marked and clinically significant misclassification, in particular when indices are close to their cutoff value. Physiological assessment should always be performed in a careful and meticulous manner to avoid procedural and technical sources of drift and ensure optimal conditions for clinical decision making.

Disclosures
M.A. van Lavieren and Dr Piek have served as speakers at educational events organized by Philips Volcano Corporation.

References

Key Words: Editorial ■ angioplasty and stenting ■ fractional flow reserve ■ physiology/function
Resting Indices of Coronary Lesion Severity: Not Always as Simple as It Seems
Martijn A. van Lavieren and Jan J. Piek

_Circ Cardiovasc Interv_. 2016;9:
doi: 10.1161/CIRCINTERVENTIONS.116.003747

_Circulation: Cardiovascular Interventions_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2016 American Heart Association, Inc. All rights reserved.
Print ISSN: 1941-7640. Online ISSN: 1941-7632

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circinterventions.ahajournals.org/content/9/4/e003747

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in _Circulation: Cardiovascular Interventions_ can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to _Circulation: Cardiovascular Interventions_ is online at:
http://circinterventions.ahajournals.org//subscriptions/