論　文　内　容　要　旨

Relationship between the Selvester QRS Score and Coronary Microvascular Dysfunction Assessed by the Index of Microcirculatory Resistance

（Selvester QRS スコアと微小循環抵抗指数によって評価される冠微小血管障害との関係性）

Internal Medicine, in press.

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Objective; Coronary microvascular dysfunction (CMD) plays a major role in determining myocardial ischemia in many cardiovascular conditions. The index of microvascular resistance (IMR) is used as an evaluation method specific for diagnosing CMD during cardiac catheterization. IMR is an invasive method for quantifying the coronary microvasculature independent of the presence and degree of epicardial stenosis, whereas the Selvester QRS score, which is related to myocardial damage, is a relatively simple and non-invasive measurement procedure. In this study, we investigated the relationship between the QRS score and coronary microvascular dysfunction (CMD) assessed via IMR.
Methods; We retrospectively reviewed the coronary angiography data of 96 consecutive patients who underwent invasive coronary physiological measurements (including IMR) at Hiroshima University Hospital from June 2016 to July 2020. We excluded patients who underwent invasive coronary physiological measurements for lesions due to acute or old myocardial infarction (MI) (n=8) and postcoronary artery bypass grafting (n=3). As patients with unsuitable ECG for analyses, we also excluded patients with left or right bundle branch blocks (n=8), and ventricular paced ECG (n=3). Thus, the IMR and Selvester QRS scores of 74 patients were analyzed in this study. We used a standard 5-French coronary catheter without side holes to perform coronary angiography. The pressure sensor was positioned at the distal segment of the target vessel while we performed these physiological measurements such as fractional flow reserve (FFR), The coronary flow reserve (CFR) and IMR. A thermodilution curve was obtained by using three injections of 3 mL of room temperature saline to derive the resting mean transit time (Tmn). Hyperemia was induced by continuous venous adenosine infusion (180 μg/kg/min) via peripheral or central vein. We measured IMR by the hyperemic mean transit time and distal coronary pressure. QRS scores were calculated manually by two cardiologists employing the simplified Selvester QRS scoring system, which is based on the Q or R wave duration, R or S wave amplitude, and R/Q or R/S amplitude ratio. All patients had blood tests and transthoracic echocardiography at least a few days before they underwent invasive coronary angiography.
Results; The mean age of the study population (70% male) was 71 ± 9 years. After determining the best cutoff value for the QRS score to predict IMR ≥25, which was defined as CMD by the Coronary Vasomotion Disorders International Study Group, patients were categorized into the QRS score ≥3 (n=16) and the QRS score 0-2 (n=58) groups. Patients in the QRS score ≥3 group were likely to exhibit higher rates of previous MI, chronic atrial fibrillation, and higher NT-pro BNP in comparison to the QRS score 0–2 group; however, the differences were not statistically significant (p=0.06, p=0.08 and p=0.09). There were no significant differences in LV ejection fraction, LV end-diastolic volume index, LV end-systolic volume index, LV mass index, or left atrial volume index values of the patients in

the QRS score ≥3 and QRS score 0–2 groups. However, the QRS score ≥3 group had significantly higher rates of grade ≥3–4 mitral regurgitation and systolic pulmonary arterial pressure in comparison to the QRS score 0–2 group (p=0.02 and p=0.01). Patients in the QRS score ≥3 and QRS score 0–2 groups had similar CFR (2.6 vs. 3.0, p=0.22) and FFR (0.83 vs. 0.83, p=0.88) values. However, the median IMR of the QRS score ≥3 group was significantly greater than that of the QRS score 0–2 group (31 [IQR:19–57] vs. 20 [IQR: 14–29]; (p<0.01). And the percentage of patients with IMR ≥25 in the QRS score ≥3 group was significantly greater than that in QRS score 0–2 group (69% vs.34%, p=0.01). In the univariate analysis, QRS score ≥3 and NT-pro BNP were associated with IMR ≥25 (QRS score ≥3; odds ratio [OR] 4.18, 95% confidence interval [CI] 1.33–14.86, p=0.01, NT-pro BNP; OR 1.03, 95% CI 1.00–1.07, p=0.04, respectively). The multivariate logistic regression analysis showed that QRS score ≥3 was an independent predictor of IMR ≥25 (OR 3.56, 95% CI 1.05–13.33, p=0.04).

Discussion; Several previous studies have reported that IMR values are correlated with infarct size, that they can predict the recovery of the LV function, and that only IMR was an independent predictor of major adverse cardiac events in patients with ACS who had undergone successful PCI. Additionally, IMR was an independent predictor of poor clinical outcomes, even for patients with nonsignificant coronary artery stenosis. These findings show that IMR can function as a surrogate marker of the microvascular function and poor cardiac outcomes. Selvester's QRS score reflects myocardial damage influenced by diverse factors, including previous MI, chronic atrial fibrillation, and heart failure. In this study, patients in the QRS score ≥3 group exhibited higher rates of previous MI, chronic atrial fibrillation, and higher NT-pro BNP in comparison to the QRS score 0–2 group. These factors and other arteriosclerotic diseases may cause the gradual progression of CMD, or CMD would cause myocardial remodeling, fibrosis, and scarring or myocardial damage as the outcome of the progression of CMD. We hypothesize that these mechanisms explain why a higher QRS score is associated with higher IMR. This retrospective study was conducted in a single institution; therefore, a selection bias and a small sample size are major limitations. Moreover, we performed physiological measurements on different coronary arteries in each patient. IMR values could differ between different arteries due to anatomical reasons. The present study included patients with previous MI; however, we did not collect data related to these events (e.g., peak creatine phosphokinase). Because a previous MI was found in the clinical record, it is possible that we missed a silent MI.

Conclusions; A higher QRS score was associated with CMD, as estimated by IMR. The Selvester QRS score is noninvasive parameter that is potentially useful for predicting CMD.