ischemic adaptation in group C versus group N. Unfortunately, the authors have not taken into account that the ECG measures the sum of CR and IP and not IP, as they indicated for the group N (see above). As long as one cannot be certain that the instrument for the measurement of collateral flow is very sensitive, it is conceptually wrong to disregard a contribution of CR to IT in patients with (possibly) poor collateral channels. Considering the quality of their Figure 1, it is questionable whether the accuracy and precision of MCE are sufficient to discern subtle changes in collateral perfusion during subsequent occlusions, a prerequisite to answer the question of this study. Using the alternative conclusion, the interpretation of the data of the study is straightforward:

1. MCE was sharp enough to detect collateral perfusion during the first occlusion in group C.

2. The group with well developed collateral channels did not reveal marked ST segment changes during the first occlusion because the collateral channels were sufficient to (almost) prevent myocardial ischemia. "Sufficient" collateral channels providing a flow ≥30% compared with the antegrade flow through the patent vessel prevent intracoronary ECG signs of ischemia (2,3).

3. Absent ECG signs to start with in group C could not diminish further during subsequent occlusions, even in the presence of IP or prominent CR, or both (i.e., in this situation, the ECG was too blunt to detect IT due to CR or IP). However, it did not detect no IP.

4. Conversely, MCE was too blunt to detect collateral perfusion during the first occlusion in group N.

5. The collateral perfusion present but undetected in group N was insufficient to prevent ECG signs of myocardial ischemia. It cannot be determined whether the reduction of ST segment elevation during subsequent occlusions was caused by CR or IP. Data from our laboratory using intracoronary measurements of collateral flow indicate that CR contributes to diminished ECG signs of ischemia during repeated occlusions also in patients with few collateral channels.

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Reply

In animal experiments, it has been shown (1–3) that ischemic preconditioning (IP) occurs in the absence of collateral recruitment (CR). In a recent issue of the Journal (4), we studied whether IP also occurs in humans. Myocardial contrast echocardiography (MCE) was used to demonstrate that ischemic tolerance is acquired independently of CR in patients during repeated coronary occlusion and hence to conclude that IP and CR may play independent roles in ischemic adaptation in humans as well as in animals.

Seiler assumed the presence of significant collateral circulation, which was too poor to be detectable with MCE, and claimed that collateral flow contributes to IP. His consideration is based on his own data that intracoronary measurements of collateral flow increased during repeated coronary occlusion in patients with few collateral channels (5,6). Although the question he raised is quite interesting and important, it is difficult to admit all of his claims. Epicardial collateral flow may well be different from myocardial perfusion through collateral channels. This difference has been clearly shown even in humans by several groups. In addition, MCE is usually more sensitive than other conventional techniques in detecting myocardial perfusion in humans. Most important, the presence of epicardial collateral flow, which is commonly assessed with coronary angiography and measurements of coronary flow velocity patterns, is not necessarily evidence of myocardial perfusion through collateral channels (7,8). Epicardial collateral steal and changes in the hemodynamic state are included in such features. Of course, there may well be some collateral perfusion even in patients without MCE-determined collateral flow. However, we may state that 1) MCE is the only currently available method for assessing myocardial perfusion through the collateral circulation in the clinical setting; 2) it is remarkable how the two groups of patients can be differentiated with the data of MCE-determined collateral flow; and 3) many experimental investigations have shown evidence of IP independently of CR. Accordingly, we may conclude that IP occurs independently of CR during repeated coronary occlusions in humans, at least in terms of MCE-determined CR.

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Angiographic Findings and Outcome in Diabetic Patients With Myocardial Infarction—the GUSTO-I Experience

In their article on the results of thrombolytic therapy in diabetic patients, Woodfield et al. (1) found a higher mortality rate among