Minimizing injuries from acute myocardial infarction

Reperfusion therapy is currently the mainstay treatment of acute myocardial infarction, as it salvages myocardial cells from ischemic cell death. However, abrupt restoration of coronary blood flow induces another type of cell death called “lethal reperfusion injury,” which attenuates the beneficial effects of reperfusion therapy. Despite extensive efforts to overcome this adverse phenomenon for decades, no approach has proven successful in preventing this injury so far.

We recently reported a new approach for protection against lethal reperfusion injury, which we termed *postconditioning with lactate-enriched blood*. This approach consists of intermittent reperfusion and timely injections of lactated Ringer’s solution directly into the culprit coronary artery instead of abrupt restoration of coronary blood flow to the ischemic myocardium. In our protocol, the duration of each brief reperfusion was prolonged stepwise from 10 to 60 s. Lactated Ringer’s solution (20–30 mL) was injected directly into the culprit coronary artery at the end of each brief reperfusion. Each brief ischemic period lasted 60 s, during which the injected lactate was trapped inside the ischemic myocardium. After 7 brief cycles of ischemia and reperfusion, full reperfusion was performed. The brief 60-s reperfusion was repeated twice at the end of the postconditioning protocol.

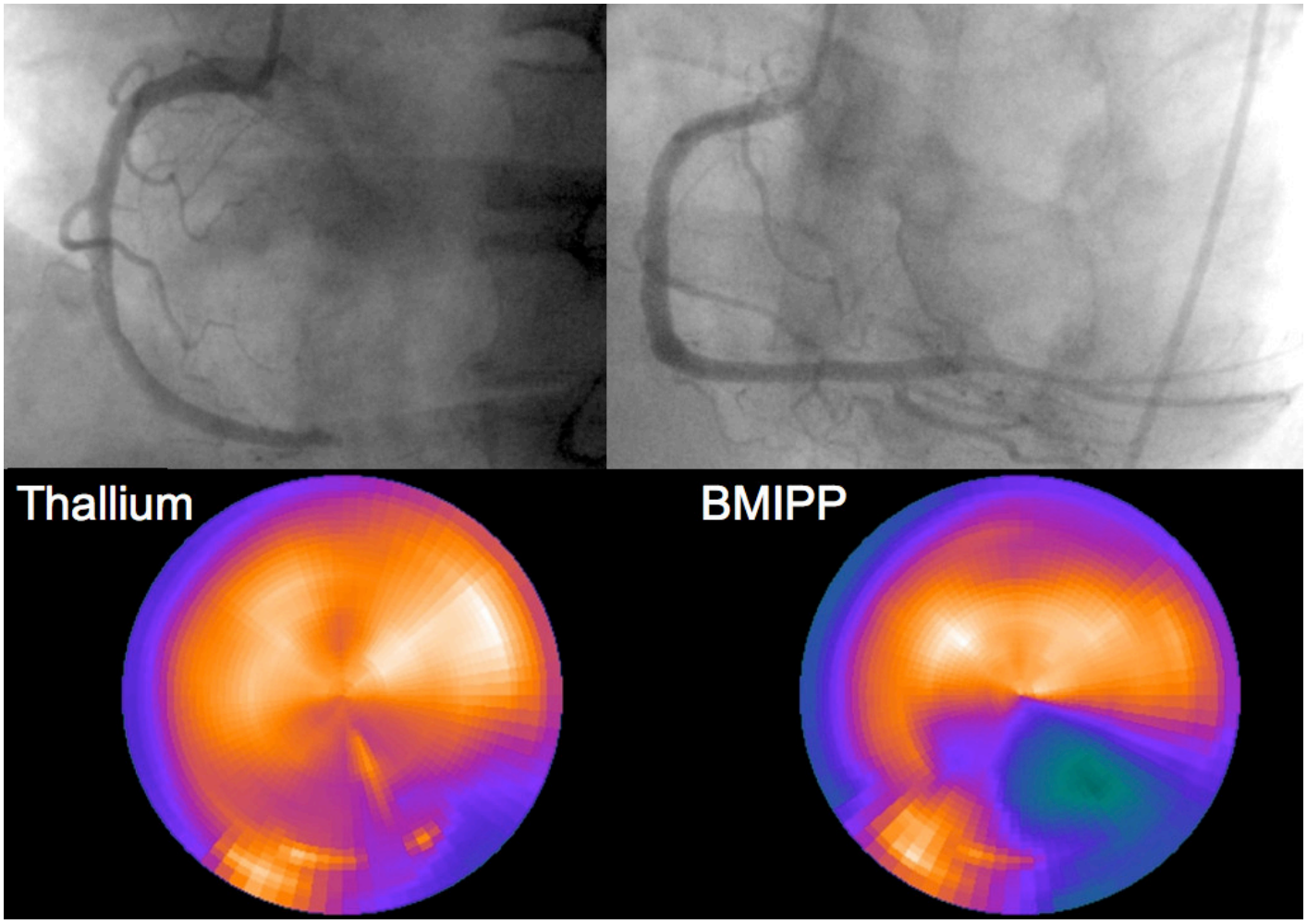

Fig. 1. Coronary angiogram (CAG) before and after the completion of reperfusion therapy and dual-loading scintigraph with thallium-201 and iodine-123 beta-methyl-p-iodophenylpentadecanoic acid (BMIPP) before discharge. Upper left panel: CAG obtained prior to reperfusion therapy. The proximal right coronary artery (RCA) is completely occluded. Upper right panel: CAG obtained after completion of reperfusion therapy. Lower panel: Bull's-eye view of a dual-loading scintigraph obtained before discharge, with thallium-201 and iodine-123 BMIPP. The uptake of thallium by the myocardium in the RCA area is good, in stark contrast to the large defect observed on BMIPP imaging.

This new approach is aimed at achieving controlled reperfusion with cellular oxygenation and minimal lactate washout from the cells in the early reperfusion period. It thereby prevents the rapid restoration of vigorous myocardial contractions that are hazardous to the myocardium already damaged by prolonged ischemia. During ischemia, myocardial cells cease contraction to save adenosine triphosphate, an energy compound inside the cells, by accumulating lactate. Upon reperfusion, lactate is easily washed away and the myocardium immediately resumes vigorous

contractions. Our new approach uses lactate as an inherent contractile activity blocker, keeping tissue lactate concentration high during the early reperfusion period. In a way, this method lessens the abrupt environmental changes induced by reperfusion. The tissue environment surrounding the myocardium during ischemia completely differs from that after reperfusion. Our new approach allows a smoother transition from ischemia to reperfusion, minimizing violent environmental changes in the myocardium.

Dual-loading scintigraphy using thallium-201 and iodine-123 beta-methyl-p-iodophenylpentadecanoic acid (BMIPP) is often used for detecting viable, damaged myocardium after an ischemic episode. Thallium-201 imaging reveals myocardial viability, whereas iodine-123 BMIPP imaging reveals myocardial metabolic disorders. Mismatched area in both imaging represents reversible ischemic myocardial injury. Large mismatched areas are often observed in patients with angina pectoris but rarely observed in patients with acute myocardial infarction. However, a large mismatched area (i.e., an extensive discrepancy in tracer uptake) with an excellent thallium uptake by the reperfused myocardium is frequently observed in patients with acute myocardial infarction treated using our new approach (Fig. 1). In our new approach, this extensive discrepancy of tracer uptake possibly reflects potent myocardial salvaging effects, at the expense of a temporal, extensive metabolic disorder in the myocardium.

Publication

An extensive discrepancy in myocardial uptake of thallium-201 and iodine-123 BMIPP in a patient with ST-segment elevation myocardial infarction treated using postconditioning with lactate-enriched blood.
Koyama T, Munakata M, Akima T, Kanki H, Ishikawa S
Int J Cardiol. 2015 Nov 1