Intracoronary ECG guided PCI in the contemporary catheterization laboratory. Part 2

ABSTRACT
Intracoronary ECG, which was created with unipolar guide introduced into coronary artery to analyze ischemia, was invented in 1974, and firstly performed in human body in 1985. Intracoronary ECG still remains rarely used technique for percutaneous coronary interventions (PCI). The article sums up studies dating from 1974 to 2016 which show that intracoronary ECG is useful for discovering the zones of ischemia, predicting myocardial necrosis, exploring vital myocardium, predicting myocardial recovery during primary PCI and finding new possibilities for the development of PCI. Intracoronary ECG is still very cheap and easily performed, even though it requires additional time and deserves much more interest among the staff in catheterization laboratories.

Key words: intracoronary ECG
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Intracoronary ECG in treating bifurcational lesions

Coronary bifurcation lesions remain a major therapeutic challenge with high early and late complication rates. It has been shown that angiographically high grade ostial side branch (SB) stenosis is not flow limiting and may not cause ischemia. Previous studies [1] with delayed gadolinium enhancement magnetic resonance imaging (DGE-MRI) before and after bifurcation PCI demonstrated that the occurrence of angiographic stenosis which is more than 70% in diameter is associated with periprocedural myonecrosis in the region of SB. Moreover, the post-procedural myocardial injury after uncomplicated percutaneous coronary intervention (PCI) is not uncommon [2–4] with the frequency of 5% to 30%. Although this is thought to have no clinical significance, clinical trials demonstrated the incre-
As a posthoc analysis occurred, the residual ischemia in MB (ST segment change) was also significantly related with TLR (ST segment change (+) 14.2% vs. ST segment change (−) 3.6%, P = 0.031) but not in SB region [7]. Final residual ST elevation in the main branch is independent predictor for TLR for the following 12 months (OR = 5.3.19, CI = 1.197–23.809, P = 0.028) [8].

Another important conclusion is that the final residual ST elevation in side branch is not depended on the final side branch stenosis > 50% as well as side branch stenosis > 50% which does not mean indicate that the stenosis is hemodynamically significant when measured with FFR.

This statement is used in another study, comparing FFR result and intracoronary ECG in side branch after stenting the main branch. After stenting the main branch, there is often > 50% stenosis in the side branch, but it is rarely hemodynamically significant (FFR < 0.8), as well as there is rarely residual ST elevation in this side branch. If there is ST elevation on intracoronary ECG this could be hemodynamically significant stenosis acutely compromising SB ostium and this should be treated or distal embolization — SB may not have > 50% stenosis and usually FFR result is > 0.8.

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Myocardial preconditioning and postconditioning

It is believed that recurrent ischemic episodes fail to deplete ATP in vitro [9, 10]. Recurrent angina is found to have benefit in infarct size [11]. This concept of ischemic preconditioning was tested through angioplasty using chest pain and measuring surface ECG, lactate levels as ischemic detectors [12]. Since intracoronary ECG is proven to be more sensitive than surface ECG in detecting ischemia it is better to be used in this setting. A study using consecutive balloon inflations showed that intracoronary ECG could show preconditioning [13]. Many studies [14–19] have used intracoronary ECG to search for substances that change preconditioning. The substances which attenuate preconditioning are found to be endothelin, phenotolamine, bamilphyl- line, aminophylline, enaprilat, dipryridamole and naloxone. Other substances as nitrates, adenosine, diltiazem, nifedipine and bradykinin showed to have preconditioning effects [20–25]. Some conditions like diabetes and increased age were proven to be not deleterious in preconditioning [26, 27].

On the contrary, postconditioning is a state in which induced ischemia provides protection to myocardium against reperfusion damage. This was proved by two studies [28, 29] by measuring cardiac enzymes, cardiac function by echocardiography and measuring infarct size by 201thallium single photon emission computed tomography. They used surface ECG as a detector of ischemia and postconditioning. It would be interesting if intracoronary ECG was used and there would be differences in other endpoints.

Limitations of the intracoronary ECG

There are basically two main limitations: 1) gaining good ECG trace which is operator dependent and 2) time needed to connect the PCI wire with unipolar lead, done with sterile crocodile wire clips.

Sometimes when there is more than one wire, when stented region is long and there is too many “metal” or the connection between the wire and the unipolar lead is poor the ECG trace is not satisfactory. This problem can be tackled with adding an isolator for the guide wire like microcatheter or balloon catheter.

Other important thing is that the wire tip is required to be largely straight, the tip must not be in more than 90° J-configuration and the tip of the wire must move freely. If the tip of the wire is wedged, the lesion current will appear from wire tip, which erroneously will be interpreted as ischemic changes. Hence, the operator must turn the wire clockwise-counterclockwise to be sure that the tip is freely moving.

Conclusion

Intracoronary ECG is easy to be performed once you have the tools which are not expensive. It is performed better in detecting ischemia and it finds its location easier than surface ECG, which is proved in many applications. It is expected that coronary intervention will be fast and exact and that adding a new method will inevitably slow down the intervention. Sometimes the quality of the tracing is not good enough but could be modified at the expense of time and adding isolators that is why sterile connectors are needed. This could help making better decisions about treating the target vessel and adding information in real time about myocardial damage.

In bifurcational lesions intracoronary ECG shows the region of ischemia and it helps to decide whether to treat the side branch which could save procedural time and reduce the adverse events.

References


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