

REVIEW ARTICLE—INTERNATIONAL CORNER

Current Status of Myocardial Perfusion Imaging in Taiwan

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Abstract

In 2008 in Taiwan, the National Health Insurance (NHI) administration revised the guidelines regarding appropriately utilizing percutaneous coronary intervention (PCI) for patients with stable CAD to mandatory demonstration of functional ischemia by treadmill exercise test (TET), stress echocardiography (SE) or MPI. Notably, anatomic-based non-invasive imaging with coronary computed tomography (CT) angiography remains not reimbursed by Taiwan's NHI. According to the NHI database, the total number of MPI significantly increased from 34,016 in 2000 to 151,254 in 2016 with an annual growth rate of 21.5%, much higher than the 7.9% growth of overall nuclear medicine tests during this period. Recently we investigated the frequency of stress testing within 90 days prior to PCI for stable CAD and showed that 79.1% of patients had MPI, 66.4% had TET and only 0.05% had SE. We conclude that MPI currently plays a gatekeeper role for invasive coronary procedures for stable CAD in Taiwan.

Keywords: Coronary artery disease, Myocardial perfusion imaging, Taiwan

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Cardiovascular disease remains the leading cause of death in most countries around the world and for decades in Taiwan it has been in second position only behind cancer. For patients with stable coronary artery disease (CAD), one of the major debates regards selecting which patients might benefit from percutaneous coronary intervention (PCI) in addition to optimal medical therapy (1, 2). Previous studies have shown that the utilization of stress testing prior to cardiac catheterization and angioplasty associates with lower overall costs and better outcomes (3, 4). Practice guidelines recommend that PCI should be performed in stable CAD only for patients showing moderate to severe ischemia on non-invasive testing (5). Among non-invasive modalities for stress testing, treadmill exercise test (TET), myocardial perfusion imaging (MPI), and stress echocardiography (SE) have been the main techniques used by cardiologists to document ischemia. However, worldwide utilization patterns for these stress tests vary substantially, perhaps depending on insurance reimbursement policy, test availability, or physician training (6, 7). In this article, the current status of MPI in Taiwan will be reviewed and discussed.

Rapid growth of MPI driven by insurance policy

MPI has demonstrated its ability to stratify risk and guide revascularization for patients with known or suspected stable CAD (8–10). Taiwan's National Health Insurance (NHI) program, a single-payer universal insurance system, was established in 1995 and covers approximately 100% of the population and the vast majority of medical procedures. According to the Taiwanese NHI database (11), the total numbers of MPI significantly increased from 34,016 in 2000 to 151,254 in 2016 (Figure 1). The average annual growth rate of MPI was 21.5%, the highest among all nuclear medicine tests that grew at an average growth rate of 7.9% per year (12). We believe that the uniquely high growth of MPI arose due to two factors. First, Taiwan's NHI announced a new policy in 2008 regarding the appropriateness elective PCI (Table 1). A case review committee would regularly check the medical records of patients receiving PCI. If patients did not have non-invasive stress testing with TET, MPI, or SE documenting ischemia, then the PCI or even cardiac catheterization would not be reimbursed or the reimbursement would be taken back from the hospital. Furthermore, the hospital might be fined for

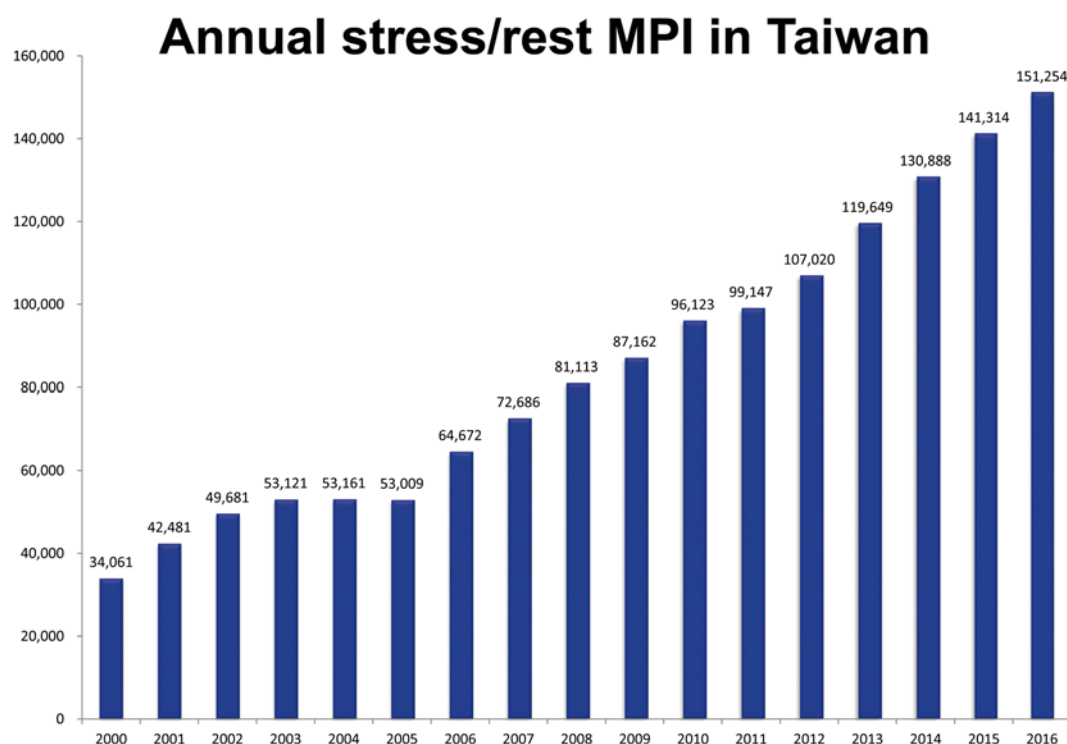


Figure 1 The annually total number of stress/rest myocardial perfusion imaging in Taiwan from 2000 to 2016. The average rate of annual increase equals 21.5% during this period.

Table 1 Taiwan National Health Insurance (NHI) policies for cardiac tests and indication for percutaneous coronary intervention (PCI)

cardiac tests approved by Ministry of Health and Welfare		NHI Indications for PCI
Tests	NHI reimbursement (cost)	
Treadmill exercise test (TET)	900 NTD (≅ 30 USD)	Acute myocardial infarction
Myocardial perfusion imaging (MPI)	6,328 NTD (≅ 205 USD)	Chronic CAD
Stress echocardiography (SE)	2,695 NTD (≅ 87 USD)	Functional ischemia on TET, MPI or SE
Coronary CT angiography	Not reimbursed	Left main >50% stenosis
Cardiac MRI	Not reimbursed	LAD, RCA or LCx >70% stenosis
Invasive coronary angiography	12,120 NTD (≅ 393 USD)	Intolerance to medical therapy

NTD: new Taiwan dollars, USD: US dollars, Left main: left main coronary artery, LAD: left anterior descending artery, RCA: right coronary artery, LCx: left circumflex artery

inappropriate medical practice. Second, coronary CT angiography (CTA) has shown strong agreement with invasive coronary angiography (CAG) and has become a major competitor to MPI and other stress testing modalities. However, the Taiwanese NHI has not yet reimbursed coronary CTA for evaluating CAD, greatly limiting its utilization in the routine work-up for CAD.

Outcome of MPI vs. CAG guided strategy

The Taiwanese NHI policies regarding stable CAD not only contributed to a tremendous increase in MPI utilization but indeed limited the overuse of invasive coronary procedures. The reduction in invasive procedures from Taiwan's insurance policy did not result in a negative effect for patients with stable CAD but actually improved outcomes according to our recent

study (13). From a random selection of 1,000,000 patients in the NHI database in 2000 we enrolled two groups of patients with suspected or known stable CAD: initial CAG versus initial MPI. The CAG and MPI groups both contained 4,495 subjects with similar age, gender, or comorbidities and were followed until the end of 2011 for revascularization (PCI or bypass surgery), myocardial infarction (MI), and all-cause mortality. The results showed that an initial MPI strategy resulted in significantly less revascularization (729 vs 2,380, $p<0.001$), fewer MI's (268 vs 1,044, $p<0.001$), and lower all-cause mortality (522 vs 784, $p<0.001$) compared to an initial CAG strategy. The adjusted hazard ratios of initial MPI compared to initial CAG were 0.24 (95% CI=0.22–0.26), 0.23 (0.20–0.26), and 0.58 (0.52–0.64) for revascularization, MI, and all-cause mortality, respectively.

MPI as the gatekeeper of PCI

More recently we used Taiwan's NHI database to investigate the frequency of stress testing (including TET, MPI, and SE) within 90 days prior to PCI for stable CAD (14). In general, cardiologists would prefer tests that they can perform themselves (such as TET or SE) compared to MPI that can only be performed by nuclear medicine physicians in Taiwan. Surprisingly, the result showed that 79.1% of the patients had MPI, 66.4% had TET, and only 0.05% had SE among those with at least one stress test. Our interpretation of this result was that TET was more likely a screening test for low pre-test likelihood patients and a relatively lower portion of patients would proceed to invasive coronary procedures after TET. On the other hand, SE was not the test of choice for most cardiologists in Taiwan due to the complexity of technique, high operator-dependence, and the very low NHI reimbursement (Table 1). With the advantages of easy accessibility of nuclear tests and plenty of outcome evidence, cardiologists preferred MPI for patients with a relatively higher probability of requiring PCI.

Conclusions

MPI currently plays a gatekeeper role in Taiwan for invasive coronary procedures in stable CAD. However, challenges remain for MPI, including strong competition from other non-invasive imaging modalities and the intrinsic problems of relatively high radiation exposure, frequent artifacts from attenuation and motion, and relatively poor resolution. We need to continue working hard on improving MPI so that we can maintain or further expand its applications in both academic research and daily patient care.

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Conflicts of interest

None.

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References

1. Boden WE, O'Rourke RA, Teo KK, et al. Optimal medical therapy with or without PCI for stable coronary disease. *N Engl J Med* 2007; 356: 1503-16.
2. Cheng-Torres KA, Desai KP, Sidhu MS, et al. Conservative versus invasive stable ischemic heart disease management strategies: what do we plan to learn from the ISCHEMIA trial? *Future Cardiol* 2016; 12: 35-44.
3. Shaw LJ, Hachamovitch R, Berman DS, et al. The economic consequences of available diagnostic and prognostic strategies for the evaluation of stable angina patients: an observational assessment of the value of precatheterization ischemia. Economics of Noninvasive Diagnosis (END) Multicenter Study Group. *J Am Coll Cardiol* 1999; 33: 661-9.
4. Anderson HV, Shaw RE, Brindis RG, et al. Relationship between procedure indications and outcomes of percutaneous coronary interventions by American College of Cardiology/American Heart Association Task Force Guidelines. *Circulation* 2005; 112: 2786-91.
5. Smith SC Jr, Feldman TE, Hirshfeld JW Jr, et al. ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/SCAI Writing Committee to Update 2001 Guidelines for Percutaneous Coronary Intervention). *Circulation* 2006; 113: e166-e286.
6. Lin GA, Dudley RA, Lucas FL, et al. Frequency of stress testing to document ischemia prior to elective percutaneous coronary intervention. *JAMA* 2008; 300: 1765-73.
7. Vitola JV, Shaw LJ, Allam AH, et al. Assessing the need for nuclear cardiology and other advanced cardiac imaging modalities in the developing world. *J Nucl Cardiol* 2009; 16: 956-61.
8. Hachamovitch R, Berman DS, Kiat H, et al. Exercise myocardial perfusion SPECT in patients without known coronary artery disease: incremental prognostic value and use in risk stratification. *Circulation* 1996; 93: 905-14.
9. Iskander S, Iskandrian AE. Risk assessment using single-photon emission computed tomographic technetium-99m sestamibi imaging. *J Am Coll Cardiol* 1998; 32: 57-62.
10. Hachamovitch R, Hayes SW, Friedman JD, et al. Comparison of the short-term survival benefit associated with revascularization compared with medical therapy in patients with no prior coronary artery disease undergoing stress myocardial perfusion single photon emission computed tomography. *Circulation* 2003; 107: 2900-7.
11. Database NHIR, Taiwan. National Health Insurance Research Database website. <http://nhird.nhri.org.tw/en/>. Accessed April 23, 2017.
12. Huang YY, Hung MC, Lin LF, et al. The utilization of nuclear medicine studies and the dilemma in Taiwan: a brief report. *Ann Nucl Med Mol Imaging* 2016; 29: 166-78.
13. Hung GU, Ko KY, Lin CL, et al. Impact of initial myocardial perfusion imaging versus invasive coronary angiography on outcomes in coronary artery disease: a nationwide cohort study. *Eur J Nucl Med Mol Imaging* 2018; 45: 567-74.
14. Yang HP, Hung GU, Lin CL, et al. The utilization of stress tests prior to percutaneous coronary intervention for stable coronary artery disease in Taiwan. *Acta Cardiol Sin* 2019; 35: 111-7.