Chapter 2

RATIONALE AND OBJECTIVE

Restenosis is the decrease of the vessel lumen at the site of the procedure, occurring in 40% to 50% of cases.(2,3) Restenosis is usually accompanied with chest pain, but it may also be asymptomatic. The majority of restenosis develops within the first 3 to 4 months after the procedure; lumen narrowing is usually completed by 6 months. Restenosis can be defined as histologic, clinical, or angiographic. Angiographically significant restenosis is those with > 50% stenosis or with > 30% lumen reduction from the initial successful result.

The sequence of events that leads to restenosis begins with the arterial physical injury created by the balloon or other devices. Thereafter a complex cascade begins, involving inflammation and thrombotic mechanism, intimal hyperplasia, and vessel recoil. The restenosis process has been described as a process similar to that of wound healing. A classification of the pathogenesis of restenosis into phases may apply on the basis of recent data: early elasic recoil (first day), formation and organization of mural thrombus (first 2 weeks), and neointimal proliferation (first 3 months). Chronic geometric changes of the vessel occur at the same time.

The regional distribution of myocardial perfusion can be visualized by using a radiopharmaceutical agent that accumulates proportional and regional myocardial blood flow. The most important clinical implication of myocardial perfusion imaging is in conjunction with stress testing for evaluation of ischemic heart disease. Numerous investigator have shown the diagnostic usefulness of exercise myocardial perfusion imaging using either thallium-201 or the Tc-99m sestamibi labeled imaging agents. General agreement is found between the results of stress myocardial perfusion imaging and the findings of contrast coronary angiography.

Stress myocardial perfusion imaging is particularly useful after coronary angioplasty because often only one vessel is dilated and its vascular territory can be readily evaluated with SPECT imaging. The optimal timing of imaging after angioplasty is controversial. Some investigators reported a high incidence of false-positive myocardial perfusion abnormalities early after angioplasty, presumably because of delayed return of coronary reserve. This is not a general occurence. Most patients have normal myocardial perfusion images within the first week of successful after PTCA. At approximately 4 weeks

after coronary angioplasty, a good correlation has been demonstrated between stress-induced myocardial perfusion abnormalities and the presence or absence of restenosis, independent of clinical symptoms.(28) Therefore, stress myocardial perfusion imaging is performed in patients who develop symptom supportive of restenosis, or at 6 months in those who are asymptomatic.

Tc-99m Sestamibi, a newly developed radiopharmaceutical agent for myocardial perfusion imaging, provides an accurate, noninvasive detection of coronary artery disease and potentially detection of restenosis after successful PTCA. Tomographic localization of perfusion abnormalities allows us to determine whether clinical ischemia is likely to be caused by restenosis at the site of angioplasty or progression of disease in other coronary arteries. The SPECT image regions were assigned to the distribution of individual vessels guided by the coronary anatomy obtained from the angiogram recorded before the PTCA. Prediction of the absence or presence of restenosis was then made before angiographic reevaluation, based on the presence or absence of ischemic redistribution in the territory of the individual dilated vessels. If the new ischemic area is found in the territory area of previously normal nondilated arteries, disease progression is suspected.

Research question

Can Tc-99m sestamibi SPECT imaging accurately detect restenosis in the patients who have undergone successful percutaneous transluminal coronary angioplasty(PTCA) by comparison with coronary angiography ?.

Objectives

1) To evaluate the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Tc-99m sestamibi SPECT imaging for detection restenosis after successful PTCA

2) To compare the sensitivity, specificity and accuracy among recurrent chest pain, exercise treadmill test and Tc-99m sestamibi SPECT imaging for detection restenosis after successful PTCA

3) To evaluate the sensitivity, specificity and accuracy of Tc-99m sestamibi SPECT imaging for detection restenosis of individual vessels

4) To evaluate the sensitivity, specificity, accuracy, positive and negative predictive value of Tc-99m sestamibi imaging for detection restenosis in any type of coronary artery disease

Hypothesis

Ho (Null Hypothesis) = The sensitivity of exercise treadmill test combined with Tc-99m sestamibi SPECT imaging for detection restenosis after successful PTCA is less than 95 %

Ha (Alternative Hypothesis) = The sensitivity of exercise treadmill test combined with Tc-99m sestamibi SPECT imaging for detection resteosis after successful PTCA is higher than 95 %

Clinical Implication of the Study

1) To detect restenosis after PTCA in patients who have no chest pain or atypical chest pain within 6 months after procedure to assist in determining the need for angiographic reevaluation and consideration of management such as repeated PTCA or an interventional device (stents)

2) To differentiate myocardial ischemia after PTCA from restenosis, partial revascularization. Because the proliferation of angioplsty into multivessel has higher rates of restenosis and will continue to be an increase in the number of patients with recurrent myocardial ischemia after PTCA

3) To determine the successful of revascularization after PTCA and predict risk of restenosis and recurrence symptoms

4) To determine the optimal timing of imaging after angioplasty for the detection of revascularization and restenosis after PTCA because it is controversial now. Some investigators reported a high incidence of false-positive myocardial perfusion abnormality early after angioplasty, presumably because of delayed return of coronary reserve. This is not a general occurence.

Operational Definition

A) Restenosis is the decrease of the vessel lumen at the site of the percutaneous transluminal coronary angioplasty (PTCA) and may be determined by clinical symptom, noninvasive and coronary angiographic study by the following criteria:

1) Clinical symptoms

Recurrent chest pain, myocardial reinfarction and sudden cardiac death within 6 month after PTCA are suspected with restenosis.

2) Noninvasive study

2.1) Exercise treadmill test

If the patients develope chest pain or have abnormal ECG changes of ischemic pattern during exercise time, it is suspected with restenosis

Positive criteria of ECG during exercise or recovery phase

- Horizontal or downsloping ST segment depression > 0.10 mV in chest leads or > 0.20 mV in limb leads compared with resting ECG baseline

- ST segment elevation > 0.10 mV in leads without Q wave

2.2) Tc-99m sestamibi SPECT imaging

The presence of new lesion with reversible fill defect (ischemic redistribution) in the territory of the previous dilated vessels is suspected with restenosis.

3) Coronary angiography

Angiographic restenosis is defined as the increasing of the diameter stenosis of the dilated lesion above 50% stenosis by measurement method of quantitative coronary analysis.

B) Percutaneous transluminal coronary angioplasty (PTCA)

PTCA is the procedure of dilatation the significant stenotic (>75% of luminal diameter) coronary disease by using balloon to compress and split plaque, mural tearing, and stretch associated with medial and intimal tearing

Successful PTCA defined when(32)

- Postangioplasty residual diameter stenosis less than 30 %
- No serious complication during the procedure or hospitalization
- Decreasing myocardial ischemia determined by objective (noninvasive) studies
- Improvement in angina pectoris

C) Technetium 99m-sestamibi SPECT imaging

By using Tc-99m sestamibi combined with exercise treadmill test, the myocardial perfusion imaging patterns-in resting and exercise phase are compared and defined as reversible filling defect (myocardial ischemia) or irreversible filling defect (myocardial infarction).