Thirty-month outcome after fractional flow reserve-guided versus conventional multivessel percutaneous coronary intervention

Wongpraparut N, Yalamanchili V, Pasnoori V, Satran A, Chandra M, Maiden R, Leesar M A

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The study compared fractional flow reserve (FFR)-guided percutaneous coronary intervention (PCI) with conventional PCI in patients with multi-vessel disease (MVD). In the FFR-PCI group of patients, following the administration of intracoronary nitroglycerine, a 0.014 inch pressure guidewire was set at 0 and normalised, the pressure transducer was set at 0 and normalised, the pressure transducer was positioned distal to the stenoses, and the FFR was calculated during hyperaemia by intracoronary administration of adenosine. If the patient had a coronary stenosis and an FFR of less than 0.75, they underwent PCI. If they had an FFR of 0.75 or greater the existing medical treatment was continued. In the control group (conventional PCI), the estimation of the stenosis was made visually using angiography and PCI was performed when the stenoses were greater than 70%. Both groups of patients were given PCI with a 6Fr or 7Fr guiding catheter. The operators decided when the use of glycoprotein IIb/IIIa receptor inhibitors was appropriate.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients with stable angina, and at least 2 single lesions located in different vessels, at a particular hospital. Patients were excluded if they had incessant chest pain which was not responding to treatment, vessels that were totally occluded or supplying an akinetic territory (using visual assessment of the left ventricular angiogram), or ejection fraction of less than 50%. They were also excluded if they had a recent myocardial infarction (MI), if they had undergone coronary artery bypass grafting.

Setting
The setting was secondary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness and resource evidence were from the period 2000 - 2002. The price year was 2002.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The same patients provided both the cost data and effectiveness data. It was unclear whether the costing was carried out prospectively or retrospectively.
**Study sample**
No power calculations were reported. A total of 137 consecutive patients (312 vessels) meeting the inclusion criteria were included in the study, of which 57 (128 vessels) were in the FFR-PCI group and 80 (184 vessels) in the conventional PCI group. The mean age was 58 (+/- 10) years in the FFR-PCI group and 62 (+/- 12) years in the conventional PCI group. The groups contained 75% men (FFR-PCI) and 79% men (conventional PCI), respectively.

**Study design**
This was a single-centre study in which the patients were assigned to the treatment group according to the views of the medical staff, the preferences of the patients, and the numbers already enrolled in the two groups. The duration of follow-up was not specified clearly, although it was likely to have been 30 months. No blinded assessment was reported. The authors reported that follow-up was complete in 53 patients (93%) in the FFR-PCI group and in 70 patients (87%) in the conventional PCI group.

**Analysis of effectiveness**
The analysis was conducted on the basis of treatment completers only. The health outcomes used were major adverse cardiac events (MACEs) in hospital, which were broken down into the categories of non-Q-wave MI, Q-wave MI, death and target lesion revascularisation. After hospital discharge, MACEs were broken down into non-Q-wave MI, death, target lesion revascularisation, all revascularisation and bypass surgery. Kaplan-Meier estimates of 30-month freedom from cardiac death and 30-month freedom from MACEs were also reported. The authors reported that the two groups were matched with respect to clinical characteristics such as age, gender and major cardiovascular risk factors.

**Effectiveness results**
Eight patients (14%) in the FFR group and 19 (23%) in the conventional group experienced a MACE in hospital, (p=0.13). Seven patients (13%) in the FFR group and 18 (22%) in the conventional group experienced a non-Q-wave MI, (p=0.13), while 1 patient in each group experienced a Q-wave MI. One patient in the FFR group experienced a target lesion revascularisation, compared with 2 patients in the conventional group. There were no deaths in either group.

After hospital discharge, the number of patients experiencing a MACE was 5 (8%) in the FFR group and 19 (27%) in the conventional group, (p<0.01). Three (5%) patients received revascularisation in the FFR group compared with 16 (23%) in the conventional group, (p<0.01). One patient in the FFR group and 6 in the conventional group experienced a non-Q-wave MI (statistical significance not given). There were 3 deaths in each group.

The Kaplan-Meier survival estimate at 30 months was 93% in the FFR group and 92% in the conventional group (the difference was not statistically significant). Kaplan-Meier event-free survival at 30 months was 89% in the FFR group and 59% in the conventional group, (p<0.01).

**Clinical conclusions**
Using FFR-PCI in patients with MVD results in a lower number of vessels undergoing PCI, a lower event rate and a higher chance of 30-month survival.

**Measure of benefits used in the economic analysis**
No summary measure of benefits was used as the authors carried out a cost-consequences analysis.

**Direct costs**
No discounting was carried out as the costs were incurred during less than 2 years. The costs of cardiac catheterisation equipment (e.g. guiding catheter, catheterisation tray, and Toughy steering kit), stent and balloon, coronary and pressure guidewires, supply (contrast media), and time spent by registered nurse and radiology technologist were measured. The
cost estimates were based on actual data obtained from the hospital. Charges were used as cost proxies, without any adjustment. The price year was 2002.

**Statistical analysis of costs**
The mean costs were reported and Student's t-test was used.

**Indirect Costs**
No indirect costs were calculated.

**Currency**
US dollars ($).

**Sensitivity analysis**
No sensitivity analysis was carried out.

**Estimated benefits used in the economic analysis**
See the 'Effectiveness Results' section.

**Cost results**
The total cost was $3,167 (+/- 1,194) in the conventional group and $2,572 (+/- 934) in the FFR group, (p<0.01).

The cost of adverse events was probably not dealt with in the costing.

**Synthesis of costs and benefits**
The costs and benefits were not combined as this was a cost-consequences analysis.

**Authors' conclusions**
In patients with multi-vessel disease (MVD), compared with conventional percutaneous coronary intervention (PCI), fractional flow reserve (FFR)-guided PCI significantly reduces the number of vessels undergoing PCI, the event rate, and the cost of the procedure. In addition, the results showed that FFR-guided PCI in patients with MVD does not increase the procedure time, radiation exposure time, or amount of contrast media used in comparison with conventional PCI.

**CRD COMMENTARY - Selection of comparators**
The choice of the comparator, angiography, was justified by it having represented current practice in the authors' setting in the past. You should decide if the comparator represents current practice in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness data were derived from a single study. The study design was not appropriate in certain respects as the patients were allocated non-randomly to the different groups, no blinded assessment was reported, and the analysis was conducted on the basis of treatment completers only. The study sample was representative of the study population in that it consisted of consecutive patients satisfying the inclusion criteria. With the exception of age, the patient groups appear to have been comparable in terms of the baseline criteria. The analysis of effectiveness was handled credibly in most respects. However, the authors did not clearly state the length of the follow-up and did not discuss the higher death rate in the FFR group (3 out of 57 versus 3 out of 80 in the conventional group).
Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit. The health benefits are therefore those associated with the effectiveness outcomes.

Validity of estimate of costs
From the cost perspective adopted (i.e. that of the hospital), the costs associated with angiography, FFR, stents and balloons were included. The costs associated with treating the patients’ MACE were not included, although their inclusion would probably have increased the relative costs in the conventional group in comparison with the FFR group. The costs and the quantities were not reported separately, which will limit the reproducibility of the study in other settings. The resource use quantities were taken from a single study, while the prices were taken from the authors’ setting. No other sources were used for prices. No statistical, sensitivity or any kind of analysis of the quantities was carried out. A statistical analysis of the costs was performed, but the statistical test used was not appropriate for continuous variables. Charges, rather than costs, were reported. This practice is methodologically inferior to reporting the costs, as charges do not reflect opportunity costs, and this limits the generalisability of the study findings. The price year was reported, which will aid any future reflation exercises. Discounting was unnecessary, as all the costs were incurred during a short time, and was therefore not performed.

Other issues
The authors made appropriate comparisons of their results with the findings from other studies. The issue of generalisability to other settings was not addressed. The study referred to patients with multi-vessel disease and this was reflected in the authors’ conclusions. The authors did not present their results selectively and their conclusions reflected the scope of the analysis. The authors were aware that the lack of randomisation of patients to each treatment group was the main drawback of the study.

Implications of the study
The authors argued that using FFR with a decision to go ahead with PCI when the stenosis is less than 0.75 results in better outcomes than using angiography and proceeding when the stenosis looks less than 0.70. Further research in which patients are randomised to the two treatment possibilities would be helpful.

Source of funding
None stated.

Bibliographic details

PubMedID
16188509

DOI
10.1016/j.amjcard.2005.05.040

Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Angioplasty, Balloon, Coronary /adverse effects /economics /methods; Coronary Angiography; Coronary Circulation; Coronary Disease /pathology /radiography /therapy; Costs and Cost Analysis; Disease-Free Survival;
Female; Humans; Male; Middle Aged

**AccessionNumber**
22005001547

**Date bibliographic record published**
31/05/2006

**Date abstract record published**
31/05/2006