

The 9th Conference on Health Care of the Chinese in North America



A Renaissance in Interventional Cardiology

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Abstract

History of Interventional Cardiology

Interventional cardiology was born when Andreas Gruentzig performed the first percutaneous transluminal coronary angioplasty (PTCA) in 1976. In the 1980's angioplasty equipment was refined and the limitations and pitfalls of PTCA were identified. Several new devices were developed as alternatives or adjuncts to balloon angioplasty. In particular, the vascular stent, a metal tube which scaffolds the artery open, was first introduced in a human coronary artery in 1986, the most important occurrence in coronary angioplasty since its inception.

Trials of PTCA versus CABG

Many trials comparing PTCA to CABG were initiated in the mid to late including BART, CABRI, GABI, EAST and MASS. The trials varied somewhat in design and patient selection, with some including single and others only multi-vessel coronary artery disease, but they were consistent in their findings. There were no differences in death or myocardial infarction over 1 to 5 years when surgery or angioplasty was selected to treat the symptomatic coronary artery disease. However, patients treated with angioplasty were more likely to have angina and to have required a repeat intervention at 1 to 5 year follow-up.

The Single Vessel Paradox

By combining the data from these trials a curious and counter-intuitive finding arises. The patients who benefited the most from bypass surgery compared to angioplasty were those with single, not multi, vessel disease. The explanation for this likely arises from the specific vessel which is considered for bypass surgery even when it is the only vessel with significant disease, the left anterior descending coronary artery (LAD). The LAD is the most important of the three coronary arteries (including the right and the circumflex coronary arteries), due to the larger amount of myocardium subtended. Additionally, this vessel is the one in which surgery carries the greatest long-term benefit, because it is bypassed with the left internal mammary artery (LIMA) rather than saphenous vein grafts. The patency of the LIMA far exceeds that of saphenous vein grafts, with 90% 10 year patency as opposed to only 50% with vein grafts.

Not only is the LAD better served by bypass graft surgery than the other vessels, but the long-term benefit of traditional PTCA is weaker for this vessel, as a result of higher rates of recurrence with follow-up. Restenosis is a process which usually occurs within 6 months of balloon angioplasty and occurs in approximately 30-50% of angioplasty procedures. The incidence of restenosis is higher for LAD's than the other arteries, around 50% as opposed to 30%. The reasons for this are not apparent.

Stentmania

In the last few years a revolution which is stent-mania has occurred. Now the use of metal scaffolding devices, the vascular stent, is being used in up to 70% of angioplasty procedures. Stents make angioplasty safer, by reducing the complication of abrupt closure of the artery from about 5% to less than 1%. Because of this reduced risk, it is possible to achieve a better acute result, which translates into improved longterm results, less restenosis and a more durable procedure. The device does not abolish restenosis, because the placement of a foreign body promotes the development of increased tissue proliferation as part of the healing process, and because not all obstructions are amenable to stent implantation, but in appropriate lesions, the incidence of restenosis is markedly diminished. Fortuitously the artery which seems to be associated with the greatest anti-restenosis benefit of stents is the LAD. This will dilute the relative benefits of coronary artery bypass surgery compared to coronary angioplasty, and make angioplasty an even more attractive option.

Anti-platelet therapy

Another important leap in angioplasty been occurring simultaneously. That is the recognition of the importance of powerful anti-platelet agents in percutaneous procedures. The anti-platelet agent ticlopidine, for example, is more effective than the anti-coagulant warfarin in reducing the incidence of stent thrombosis. And blockers of the IIb-IIIa glycoprotein receptors, found on platelets, reduce the incidence of myocardial muscle damage during PTCA, making the procedure safer.

Balloon Valvuloplasty

In 1979 the first balloon procedure was performed by Semb on a stenotic heart valve to treat pulmonary stenosis and has become the procedure of choice for this congenital condition. In 1982 a Japanese cardiac surgeon, Inoue, performed the first balloon valvuloplasty to treat rheumatic mitral stenosis. For the past decade investigators have been refining this technique and evaluating its benefit as compared to the surgical alternatives. Balloon mitral valvuloplasty is now the second most common procedure performed by interventional cardiologists. Although currently less common in the United States, mitral stenosis is quite prevalent in many other countries, especially India and China. It is estimated that there are 3 million individuals in China suffering from this condition.

The largest series on the use of balloon valvuloplasty in the treatment of rheumatic mitral stenosis comes from Chinese investigators who reported on the results of this procedure in over 4800 individuals. They found an initial success rate of 99%, with initial complications

in 2% and a 3 year follow-up restenosis rate in 5%. Hemodynamic improvements were seen in left atrial, pulmonary artery and mitral gradient pressures with a doubling of the mitral valve area. These same investigators recently reported 10 year hemodynamic follow-up in over 200 patients, demonstrating that the initial hemodynamic results achieved were largely maintained over this follow-up period.

Balloon valvuloplasty compared to surgical commisurotomy

Two trials from India randomized patients to balloon valvuloplasty or surgical commisurotomy. One trial examined closed commisurotomy which has been used in developing countries, and the other to open commisurotomy, the surgery preferentially performed in western countries. In both trials the clinical and hemodynamic results seen with balloon valvuloplasty were equal to or better than the results seen with surgery.

Balloon valvuloplasty can be performed within an hour or two and the patient can go home the following day without having to recuperate from having the chest cut open. With the work which has only become available in the last few years, balloon valvuloplasty has now become the procedure of choice for selected patients with rheumatic mitral stenosis.