Efficacy and Safety of Coronary Balloon Angioplasty and Directional Atherectomy

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In this issue of Circulation, Safian et al describe their experience with directional coronary atherectomy. The procedure was successful in removing 88% of lesions, and only one of 67 patients required emergency coronary bypass surgery. However, according to life-table analysis, 30% of the lesions restenosed in the ensuing 6 months. Thus, coronary atherectomy appears to be effective and safe in selected patients, but the incidence of restenosis is high.

How do the results of this study and those from other centers using this procedure compare with those of balloon angioplasty? In comparison to angioplasty, does coronary atherectomy offer improved success or a lower incidence of complications? Such an analysis may be somewhat difficult to make for at least two reasons. First, a comparison of a new technology to an established one may place the new one at a disadvantage, since operator experience is limited and equipment design may be relatively primitive. Second, these limitations may influence patient selection, so that the procedures may be performed in dissimilar patients in whom coronary stenoses are not comparable. With these caveats in mind, a comparison of the benefits and risks of coronary angioplasty and atherectomy is in order.

Initial Success

Since the first coronary angioplasty was performed in 1977, balloon dilatation has been performed in hundreds of thousands of patients. In the early 1980s, it was successful in only about 60% of patients, most of whom had stenoses that were confined to one coronary artery, proximal in location, discrete, and noncalcified. During the latter half of the decade and continuing to the present, angioplasty has been successful in 85% to 90% of patients, many of whom have extensive disease of several coronary arteries. The incidence of success with directional coronary atherectomy is almost identical to that with angioplasty, though the currently available device cannot be used in tortuous coronary arteries or in the more distal portions of nontortuous ones. In the report of Safian et al, atherectomy was initially successful in removing 88% of lesions, and the preliminary experience with more than 500 stenoses at eight centers is similar (88% success). In short, angioplasty and atherectomy achieve initial success in similar percentages of operations for coronary stenoses (85% to 90%).

Although atherectomy usually leaves the patient with less of a residual stenosis than does angioplasty, the significance and consequences of this difference are uncertain. Atherectomy caused a reduction in stenosis diameter to only 5% ± 15% of original, whereas angioplasty often leaves the patient with a modest residual diameter stenosis averaging 30% to 40%. Although previous studies with angioplasty have indicated that the incidence of restenosis is related to the severity of the post-angioplasty residual stenosis, the available data on atherectomy suggest that restenosis occurs commonly even though the residual stenosis is minimal.

Short-Term Complications

Of the 10% to 15% of angioplasties that are unsuccessful, about half are due to an inability to cross or to dilate the stenosis, and the other half are unsuccessful due to abrupt closure of the artery after dilatation. Thus, acute occlusion occurs in 4% to 5% of patients undergoing angioplasty and accounts for most of the morbidity and mortality associated with it. Overall, angioplasty is associated with a 3% to 5% incidence of subsequent myocardial infarction, a 2% to 3% incidence of subsequent emergent bypass surgery, and a 0.5% to 1.0% incidence of death. The incidence of acute complications of directional atherectomy appears to be similar. Safian et al indicated that atherectomy was unsuccessful in nine of 76 coronary stenoses (12%); the lesion could not be crossed with the device in seven; an unsatisfactory result was obtained in one; and extensive dissection of the coronary artery occurred in one, requiring emergent bypass surgery. In comparison, the multicenter experience has been of a somewhat higher incidence of acute complications. Major coronary arterial occlusion occurred in 15 of the 480 patients (3.1%), branch vessel occlusion...
in 19 (4.0%), and coronary dissection by the guiding catheter in three (0.6%), so that emergent bypass surgery was required in 4.4%. Myocardial infarction occurred in 4.8%, and in-hospital death occurred in 0.6%.5 Thus, angioplasty and atherectomy are associated with similar short-term morbidity and mortality.

It is uncertain whether the pathophysiological mechanisms of abrupt closure following angioplasty and atherectomy are similar. Abrupt closure after angioplasty is usually caused by extensive dissection, with injury to the deeper layers of the arterial wall and resultant intramural hemorrhage. Seventy percent to 100% of patients with abrupt closure have angiographic evidence of dissection.11-16 In contrast, there are few data that provide insight into the mechanism of abrupt closure following atherectomy. In the study of Safian et al,1 the patient requiring emergent bypass surgery had angiographic evidence of extensive dissection. Further studies and experience are needed to determine the cause of acute occlusion following atherectomy.

Long-Term Complications

Restenosis at the site of dilatation occurs in 25% to 35% of patients over the 6 months following successful angioplasty of a narrowed coronary artery, and some authors have reported it in as many as 45%.17 Restenosis occurs in 45% to 55% of patients following dilatation of a totally occluded coronary artery.18 Its incidence is somewhat increased after dilatation of stenoses of the proximal portion of the coronary arteries and the left anterior descending coronary artery.8 The data of Safian et al1 demonstrate that restenosis after atherectomy occurred in 30% of patients, and the preliminary data of Simpson et al19 indicate a similar incidence of restenosis (38% following atherectomy of native coronary arteries). It was hoped that atherectomy, as a more effective “debulker” of the coronary lesion, would reduce the incidence of restenosis, but these preliminary results do not suggest that atherectomy alters its incidence. Although the reasons for this are not known, pathological examination of specimens obtained with the atherectomy device from restenosed coronary arteries may provide insight into the mechanisms involved.

Summary

Although coronary atherectomy may prove to be useful in many patients with coronary artery disease, its results and associated complications are remarkably similar to those of balloon angioplasty. Both procedures are successful in 85% to 90% of patients; both are associated with a small but finite incidence of emergent bypass surgery, myocardial infarction, and death; and both are accompanied by a distressingly high incidence of restenosis in the ensuing 6 months. As the equipment of atherectomy is refined and operator experience increases, its benefits and risks may improve, although the benefits and risks of balloon angioplasty probably will improve similarly.

References


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