Editorial Comment

Coronary Interventions at a Crossroads:
The Bifurcation Stenosis*

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Long before the nomenclature of lesion complexity matured, side branch involvement was recognized as an unfavorable determinant of angioplasty success. Meier and Gruentzig were among the first to define the risks of side-branch occlusion associated with parent vessel angioplasty, emphasizing the importance of plaque extension into the side branch as a predictor of post-PTCA occlusion (1,2).

Balloon dilatation at a complex bifurcation stenosis can lead to plaque shift and dissection into the branch vessel. Early recognition of this predictable complication led to a variety of innovations in basic angioplasty techniques including “kissing balloons” through two guides (3,4), “kissing balloons” through a single guide (5–7), and sequential dilatation through kissing wires and a single guide (8–11). All of these bifurcation strategies were limited by the fundamental failure of balloon dilatation in simple as well as complex lesions: elastic recoil and restenosis.

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In the mid-1980s, John Simpson introduced the concept of directional coronary atherectomy (DCA) with his invention of the AtheroCath™ (DVI, Guidant Corp. Santa Clara, California) (12). The AtheroCath™ was the first in a second generation of coronary devices, evolving in response to the manifest failure of balloon angioplasty to yield a durable result for all patients. It was anticipated that clean removal of plaque (plaque “shaving” as originally described by Simpson—“debulking” as it is now characterized) would render a larger and less traumatized lumen; hence, less restenosis. This premise was ultimately tested in a relatively large clinical trial—CAVEAT (13). This trial randomized patients with stenoses in larger vessels to either angioplasty or DCA, comparing acute and 6-month outcomes. The binary restenosis rates were high in both groups, but worse in the PTCA group. A meta-analysis of CAVEAT examined the fate of side branches at bifurcations and revealed a higher rate of side-branch closure and non-Q-wave myocardial infarction in the DCA group (14).

The disappointing results of DCA in the CAVEAT trial compelled many operators to abandon directional atherectomy. The mass defection from DCA was further fueled by the advent of intracoronary stents. Kuntz et al. (15) clearly demonstrated that clinical restenosis could be effectively mitigated by securing a large initial gain in lumen dimension. The appeal of atherectomy (large residual lumens) could be realized with stenting, while demanding considerably less operator skill. Many interventionalists, including myself, believed that DCA was going to wither in the total eclipse of coronary stents.

The surprise results of CAVEAT led some investigators to question the conduct of the trial. The CAVEAT was a multicenter study with significant variation in operator experience and skills. The failure of DCA to reduce restenosis could not be reconciled with experience at several of the premier DCA centers. A popular theory arose that DCA fared poorly in CAVEAT because the procedure was not performed optimally in all collaborating centers.

The BOAT and OARS trials were subsequently completed at select institutions with a manifest commitment to DCA and substantial experience in the nuances of the technique (16,17). In these trials, aggressive atherectomy, usually coupled with adjunct balloon angioplasty, led to significant reductions in restenosis rates when compared to balloon angioplasty. Restenosis rates approached “stent-like” results. For many, these atherectomy trials were too little too late. For simple lesions, comparable results can be achieved with ever-improving stents; however, complex bifurcation stenoses remain one distinct class of lesions that have not been easily or effectively treated by stenting. Stenting of the parent vessel frequently leads to “stent jail” for the side branch. Although many of these side branches can be treated through the stent struts, the outcomes vary with individual stents and the size and angulation of the branch vessel (18–23). Attempts to stent both vessels in a complex bifurcation stenosis have been foiled by plaque shifting, stent overlap and uncovered plaque at the carina of the two vessels (24).

The unsolved problems of stenting at coronary bifurcations have left a clear opportunity for an atherectomy renaissance. Although advocated by some, high-speed rotational atherectomy (Rotablator™, Boston Scientific, Natick, Massachusetts) has unattractive features of limited burr sizes and the obligatory use of a single wire (25,26). Directional coronary atherectomy, however, has particular appeal in that it can effectively debulk larger vessels, attenuate plaque shifting and can be used with a dual wire system (27,28). In their report in this issue of the Journal, Dauerman et al. (29) have convincingly demonstrated that optimal atherectomy in true bifurcation lesions can lead to exceedingly low restenosis rates in both the parent vessel and the treated side branch (16% and 6%, respectively). These data

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are correlated with low target vessel revascularization (TVR) rates of 28% for patients treated by atherectomy and adjunct angioplasty. They contrasted these results to a noncontemporaneous but comparable group of patients at their two institutions who had undergone PTCA for true bifurcation stenoses. The need for TVR in their balloon angioplasty cohort was 53%.

The acute and 1-year results for this study are outstanding and provide compelling data to support the routine use of DCA in true bifurcation stenoses—particularly where the side branch is at least 2.5 mm in diameter. Along with origin stenoses of the left anterior descending coronary artery, true bifurcations represent a specific indication for directional atherectomy (30). An important caveat accompanies this recommendation: the present study was completed at a center that has distinguished itself for its commitment to DCA and that is noted for having a great amount of experience using the technique. The idea of “optimal atherectomy” originated with several of these authors, and their expert skill with the AtheroCath™ and large-bore guides is shared by few institutions. Their results with DCA cannot be necessarily anticipated by all operators.

Experience with DCA counts for a lot, as was demonstrated in the CAVEAT, BOAT and OARS saga. Operators with limited experience should not expect that they can easily embrace DCA and apply it to complex bifurcation lesions.

The AtheroCath™ is becoming increasingly more user friendly. Significant improvements in nose-cone flexibility and housing profile will diminish the learning-curve slope for this device and allow for broader use. The death knell for DCA was premature and probably unfair. It is unlikely that a stent solution for true bifurcations will be unaccompanied by present debulking. Considering the “stent-like” results seen in OARS and BOAT, Dauerman and his colleagues have given further justification for all interventionists to take a second look at directional atherectomy.

References