allotransplantation has been successfully used to eradicate the fatal torsades of the congenital long-QT syndrome. Complete denervation and autotransplantation were attempted in one case but failed, and the patient died while awaiting allotransplantation.[6] Present modalities of treatment[2-4] have led to a marked decrease in cardiac events and syncopal episodes. Thus these therapeutic approaches are basically correct for most patients. Our young patient was kept free of arrhythmias for 12 years, as long as pacing was effective. However, the report of seven (8%) cases of sudden death in 85 patients who underwent sympathetic denervation[4] is sobering and indicates that it is not a foolproof guarantee against fatal arrhythmias. The use of pacing, with or without β-blockade, is advocated by other authors,[2, 3] but the long-term hemodynamic deterioration induced by rapid ventricular pacing in our patient suggests that dilated cardiomyopathy may be the inevitable price that has to be paid for "electrophysiologic peace," and that cardiac transplantation may eventually be the only definitive treatment for some patients.

Atrioventricular sequential pacing (which was not available then) would probably not have prevented progressive left ventricular dilatation, although present evidence suggests that the choice of the DDD pacing modality is mandatory as soon as it becomes technically feasible in these infants. The rapid pacing rate itself was likely responsible for the left ventricular dilatation and dysfunction and not the lack of a proper atrioventricular sequence.[7-9] Rapid atrial pacing is experimentally used to produce heart failure.[10] In summary, we document the first successful use of cardiac transplantation to solve the vexing problem of an otherwise healthy young girl trapped between life-threatening arrhythmias and the unrelenting development of rapid rate pacing–induced dilated cardiomyopathy.

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Ultrasound-guided treatment of acute coronary stent thrombosis

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Stent thrombosis is one of the most severe in-hospital complications of coronary stenting. Recent studies have questioned the paradigm that this complication is the unavoidable consequence of the intrinsic stent thrombogenicity and have suggested that stent thrombosis can be prevented with an optimal technique of deployment.[1-5] We report a case of acute stent thrombosis in which intracoronary ultrasound was instrumental in revealing the presence and cause of the thrombosis and guiding further patient treatment.

A 57-year-old woman was admitted to the hospital because of a prolonged episode of chest pain at rest with electrocardiographic evidence of deep symmetric negative T-waves in the anterior leads without increase of the cardiac enzymes. Coronary angiography performed 5 days after this episode revealed normal right and left circumflex arteries, and a significant eccentric stenosis of the proximal segment of the left anterior descending coronary artery (Fig. 1 and Fig. 2, *A*). After premedication with 10,000 U of heparin and 250 mg of aspirin, the lesion was dilated with a 3.0 mm low-compliant balloon (Speedy Plus, Schneider, Zurich, Switzerland) with an inflation pressure of 8 atm maintained for 120 seconds. Because of the presence of a severe eccentric residual stenosis and a type B dissection more visible in the left superior oblique view (Fig. 1), a 14 mm Palmaz-Schatz stent (model 154 A, characterized by two spiral connections, J & J, Warren, N.Y.) was hand-crimped on the balloon used for the initial dilatation and implanted. The activated clotting time, controlled immediately before stent implantation, was well within the therapeutic range (445 seconds).

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Am Heart J 1996;132:1081-4.

0002-8703/96/$5.00 + 0 **4/4/73651**

Fig. 1. Angiogram of left anterior descending coronary artery in left superior oblique projection. Initial angiogram *(left)* demonstrated eccentric stenosis of proximal coronary segment. After balloon angioplasty *(middle)*, type B dissection was observed. Finally *(right)*, good angiographic result was obtained after implantation of two Palmaz-Schatz stents.

After stent deployment, additional dilatations were performed within the stent by using a short (10 mm), noncompliant 3.5 mm balloon (High Energy, Mansfield, Boston, Mass.) inflated up to 16 atm. An optimal stent expansion was demonstrated with angiography (Fig. 2, *B*). On-line quantitative coronary angiography (CAAS II, Pie-Medical, Maastricht, The Netherlands) measured an intrastent minimal lumen diameter of 2.89 mm and showed that the stented segment was larger than the adjacent proximal and distal reference segments (negative diameter stenosis of –6%) (Fig. 3). Intracoronary ultrasound (2.9 F, 30 MHz catheter, CVIS, Sunnyvale, Calif.), performed to confirm optimal stent expansion, was started within 10 minutes after the angiogram shown in Fig. 2, *B*; it showed a well-deployed distal segment of the stent, with a regular circular lumen (Fig. 3, *B*) matching the normal distal reference segment (Fig. 3, *A*) but with multiple bright homogeneous echoes adjacent to the stent struts and protruding into the arterial lumen. At the proximal anastomosis, an asymmetric stent expansion and lumen narrowing was observed (Fig. 3, *C*), with a large eccentric calcific plaque immediately proximal to the stent that precluded complete stent expansion and induced a severe narrowing at the inflow of the stented segment (Fig. 3, *D*). Angiography performed immediately after the intracoronary ultrasound (ICUS) examination confirmed the presence of multiple intraluminal filling defects suggestive of acute stent thrombosis (Fig. 2, *C*).

After two short dilatations with the 3.5 mm balloon and administration of an additional 5000 U of heparin, a second Palmaz-Schatz stent (model 104 A; length 9 mm) was deployed immediately proximal to the first stent; additional dilatations were performed within both stents (3.5 mm balloon, High Energy, inflated up to 20 atm). The length of the second stent was chosen on the basis of the length of the proximal stenosis, measured during the motorized pull-back of the ICUS catheter.[6] Likewise, the decision to avoid the use of a larger balloon size was based on the measurements of lumen diameter and total vessel diameter of the reference segment with ICUS (average proximal-distal values were 3.0 and 3.65 mm for lumen and total vessel, respectively) (Table I). A complete disappearance of the thrombi and a regular expansion of the stented segment were demonstrated in multiple angiographic views (Fig. 1 and Fig. 2, *D*). The complete apposition and expansion of the stents were also confirmed with a final ICUS examination. The patient was treated with aspirin (100 mg/day), and discharged the day after the procedure after an uneventful hospital stay (no electrocardiographic changes or increase in the cardiac enzymes, creatine phosphokinase 68 U/L, creatine phosphokinase MB 11 U/L after 12 hours). No complications or recurrence of angina occurred until the 1-month follow-up examination.

The persistence of a significant incidence of stent thrombosis despite stringent anticoagulation and the evidence with ICUS that the majority of the stents were incompletely expanded after conventional deployment suggest that the optimization of stent implantation is the key issue in the prevention of acute or subacute occlusion.[7] This case is an enlighting example of how stent thrombosis may develop despite a full heparinization when an incomplete stent expansion or a residual stenosis of the inflow or outflow of the stent creates flow turbulence and facilitates thrombus formation. The necessity to use ICUS for guidance of stent implantation has been questioned[8, 9] because

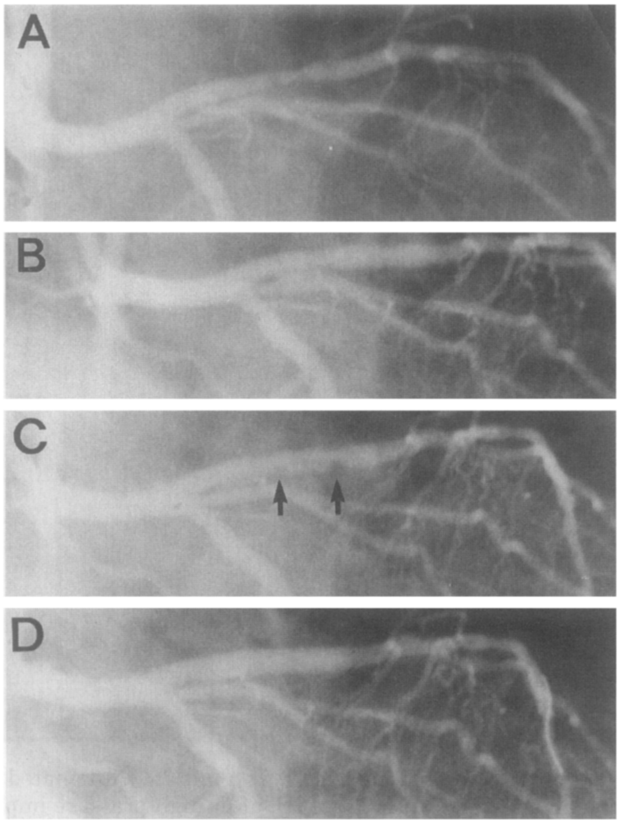

Fig. 2. Serial angiographic study of left anterior descending coronary artery (LAD) in right inferior oblique projection during coronary intervention. After deployment of 14 mm Palmaz-Schatz stent in stenosis shown in **A,** good angiographic result was observed, with stented segment larger than proximal and distal reference segment **(B).** Multiple filling defects suggestive of thrombus formation *(arrows)* were observed in proximal LAD **(C).** After second stent deployment normalized inflow of the stented segment, persistent success was obtained **(D).**

Table I. Results of on-line intravascular ultrasound analysis

*Position**	*Segment*	*L-CSA* (mm^2)	*L-DIAM* (*mm*)	*V-CSA* (mm^2)	*V-DIAM* (*mm*)	*CSA-ST* (%)
A	Distal reference	7.0	3.0	11.1	3.6	37
B	Distal stent	7.0	3.1	—	—	—
C	Proximal stent	4.8	2.5	—	—	—
D	Proximal lesion	3.4	1.9	11.4	3.7	70
E	Proximal reference	7.1	3.0	11.7	3.7	39

L-CSA, Lumen cross-sectional area; *L-DIAM,* lumen diameter; *V-CSA,* vessel cross-sectional area; *V-DIAM,* vessel diameter; *CSA-ST,* percentage of cross-sectional area stenosis, equal to (V-CSA – L-CSA)/V-CSA x 100.
*See Fig. 3.

it has been demonstrated that a marked reduction in stent thrombosis can be obtained with the routine application of the aggressive strategy of high-pressure dilatation developed by the Milan group on the basis of their clinical experience with ICUS after stenting.[1]

This case report, however, shows that residual stenosis within or adjacent to the stent can still be present after dilatation with a balloon of appropriate size at high pressure and that angiography, despite the application of on-line automated quantitative techniques, cannot always reveal an incomplete stent expansion. A rapid spontaneous thrombus dissolution was observed without the need of thrombolytic therapy, suggesting that a normal rheologic pattern within the stented segment is essential for prevention and treatment of stent thrombosis. Although large randomized trials are necessary to establish need and indications for the use of ICUS during coronary stenting, our experience suggests that ICUS is recommended in complex and long

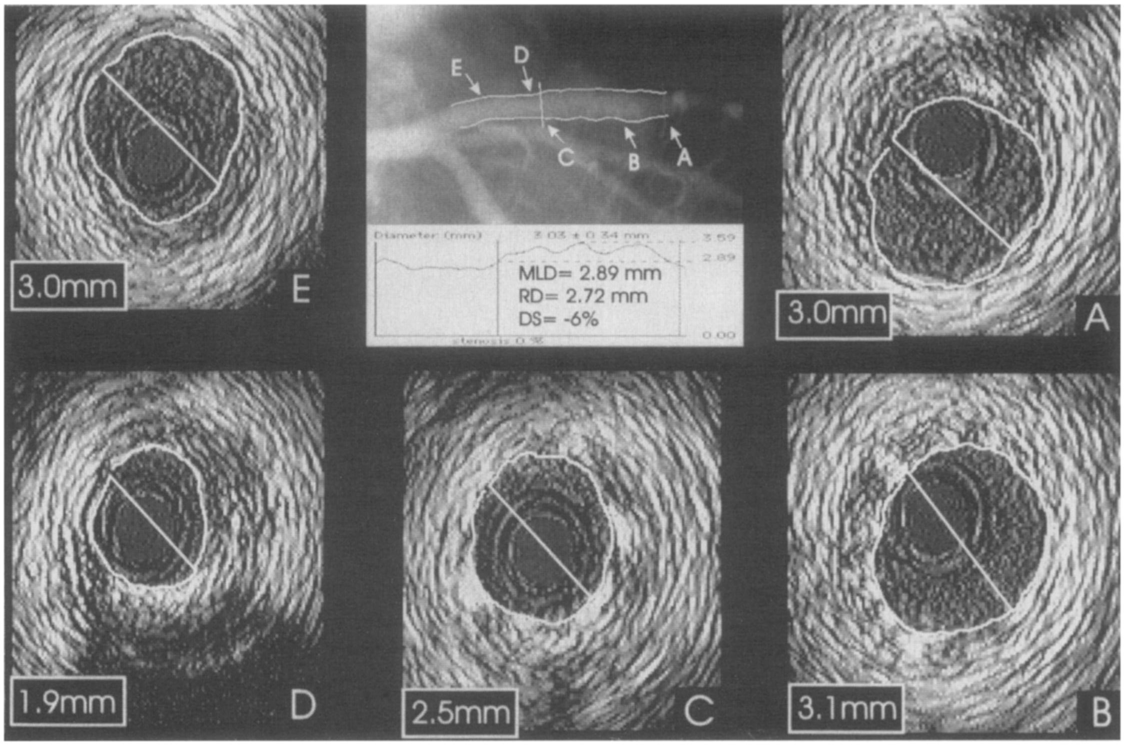

Fig. 3. Intravascular ultrasound in coronary stenting. *Top middle,* Automated contour detection algorithm has been applied to angiogram shown in Fig. 2, *B,* after high-pressure implantation of 14 mm Palmaz-Schatz stent. Note minimal lumen diameter *(MLD)* in stented segment is larger than reference diameter *(RD),* resulting in negative diameter stenosis *(DS).* Letters indicate position of intracoronary ultrasound probe for cross-sections displayed in figure; measurements are given in Table I. In proximal part of stent **(C),** asymmetric stent expansion with lumen narrowing was observed; immediately proximal to stent, large eccentric calcified plaque and severe residual stenosis were observed **(D).**

lesions and for guidance of treatment of complications during coronary stenting.

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Percutaneous transluminal coronary angioplasty in Takayasu's arteritis

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In Takayasu's arteritis coronary arterial involvement may be as high as 7%[1] by coronary arteriography or at necropsy. Young female patients are most commonly affected. In patients with these obstructive lesions aortocoronary bypass surgery may sometimes be required to preserve ventricu-

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Am Heart J 1996;132:1084-6.

0002-8703/96/$5.00 + 0 **4/4/73649**