Stabilisation of medically refractory ventricular arrhythmia by intra-aortic balloon counterpulsation


Abstract

Objective—To review the efficacy of intra-aortic balloon counterpulsation (IABCP) in medically refractory ventricular arrhythmia.


Setting—Tertiary cardiac referral centre.

Patients—21 patients (mean age 58 years) who underwent IABCP for control of ventricular arrhythmia. All had significant left ventricular impairment (mean ejection fraction 28.6%); 18 had coronary artery disease.

Results—Before IABCP, 10 patients had incessant monomorphic ventricular tachycardia and 11 had paroxysmal ventricular tachycardia and/or ventricular fibrillation (VT/VF). IABCP resulted in suppression of ventricular arrhythmia in 18 patients, of whom 13 were weaned from IABCP. After stabilisation of ventricular arrhythmia, 10 patients were maintained on medical treatment alone and one underwent endocardial resection. IABCP was maintained until cardiac transplantation in five patients. One patient had a fatal arrest before discharge and one died from progressive heart failure. IABCP failed to control ventricular arrhythmia in three patients and was subsequently discontinued. A cardiac assist device was employed in one of these until cardiac transplantation; the other two were eventually stabilised on medical treatment. Nineteen patients were discharged from hospital. Overall survival was 95% at mean follow up of 25.7 months.

Conclusions—IABCP can be an effective means of controlling refractory ventricular arrhythmia, allowing time for the institution of more definitive treatment.

(Heart 1999;82:96–100)

Keywords: ventricular arrhythmia; intra-aortic balloon counterpulsation

In patients with impaired left ventricular function, medically refractory ventricular arrhythmia can present a difficult management problem. Although an underlying arrhythmogenic substrate is necessary, the arrhythmia itself will compromise an already impaired haemodynamic state, by increasing myocardial ischaemia or left ventricular wall distension, and so exacerbate the situation. This can lead to a vicious circle of a worsening haemodynamic condition in conjunction with an increasingly arrhythmogenic myocardium. In such circumstances non-pharmacological methods of arrhythmia management such as endocardial resection and ventricular tachycardia ablation are currently employed, despite the high risk of these procedures in the unstable patient.

An alternative physical method that suppresses the arrhythmia and stabilises the haemodynamic status may allow time for implementation of appropriate drug treatment or enhance the patient's condition before a non-pharmacological approach.

Intra-aortic balloon counterpulsation (IABCP) improves coronary flow and reduces myocardial distension, thus potentially influencing ventricular irritability by direct and indirect effects. Previous reports1–3 have shown the efficacy of IABCP in the control of ventricular arrhythmias after myocardial infarction, yet the arrhythmia itself is rarely considered a primary indication for IABCP use.

In this report we describe a retrospective review of the efficacy of IABCP in controlling ventricular arrhythmia in patients resistant to antiarrhythmic drug treatment, repeated dc cardioversion, and pacing strategies.

Methods

Between 1992 and 1997, 21 patients (17 male, four female) were transferred to our unit (a cardiac tertiary referral centre) with medically resistant ventricular arrhythmia for further management, and were considered suitable for IABCP. The mean age for the group was 58 years (range 44 to 72 years). Consideration of IABCP was given to any patient with ventricular arrhythmia refractory to conventional treatment, but who would be suitable for more definitive treatment or who might otherwise have a reasonable quality of life if the arrhythmia were controlled.

Clinical details are shown in table 1. Eighteen patients had ischaemic heart disease. Five had suffered acute myocardial infarction between three and 15 days before the onset of the arrhythmia, 12 had evidence of previous myocardial infarction (more than three months before), and one presented three months after coronary artery bypass grafting for three vessel disease. Two patients had
Before transfer all patients had been loaded with intravenous amiodarone (mean cumulative dose 6.8 g, range 1.2 to 12 g), and 17 had received between one and six additional antiarrhythmic agents (median of two drugs). Suppression of the arrhythmia by overdrive ventricular or atrial pacing had been attempted without success in 11 patients.

On transfer the electrolyte status was checked and where necessary abnormalities were rectified. Amiodarone treatment was continued but all other antiarrhythmic agents were discontinued. Magnesium and β blockers were given in some patients but no additional antiarrhythmic agents were used. There was clinical evidence of reversible ischaemia in only one patient. In this patient, angiography showed two vessel disease and impaired ventricular function. Coronary angioplasty was performed on both vessels, but without resolution of the ventricular arrhythmia.

Coronary disease was evident in 18 of the 21 patients on angiography and all had impaired left ventricular function. The mean ejection fraction was 29% (range 10% to 50%) and mean left ventricular end diastolic pressure was measured at 25 mm Hg (range 14 to 50 mm Hg). The morbidity associated with emergency surgical revascularisation in haemodynamically unstable patients is well recognised and in the absence of evidence of reversible ischaemia this was not considered.

Ventricular and atrial pacing wires were inserted under fluoroscopic control in 14 patients and attempts to terminate the arrhythmia by pacing were made. Eight of these
The intra-aortic balloon pump (IABP) was inserted percutaneously under local anaesthesia through the right femoral artery and positioned in the descending thoracic aorta distal to the left subclavian artery. Counterpulsation was immediately initiated. IABCP was timed to inflate and deflate in synchronisation with the mechanical cardiac cycle triggered by the R wave on the ECG.

At the time of IABP insertion, 11 patients with paroxysmal VT/VF were in sinus or paced rhythm, in two cases after repeated dc cardioversion. Counterpulsation was used with a 2:1 ratio during arrhythmia and a 1:1 ratio when sinus rhythm was present in the 10 patients with incessant ventricular tachycardia. In these patients sinus rhythm was achieved by pace termination in three patients, dc cardioversion in three, and both methods in four.

**Results**

The use of IABP reduced the frequency of ventricular arrhythmia and stabilised the patient’s general condition in 18 of the 21 cases. There were no complications related to the use of the IABP itself. Complete abolition of ventricular arrhythmia was achieved in 14 patients and significant reduction in episodes of sustained ventricular tachycardia in four (table 3). In the 10 patients with incessant monomorphic ventricular tachycardia, IABCP resulted in successful termination of the arrhythmia (using the treatments described above in Methods) within 30 to 85 minutes.

Removal of the IABP was considered after at least 24 hours of haemodynamic and arrhythmia stability. Ventricular arrhythmia was controlled to the extent that it was possible to withdraw mechanical support in 13 patients. Stabilisation of ventricular arrhythmia on medical treatment was maintained in 10 of these patients. Of the remaining three patients, one underwent endocardial resection. Another patient had evidence of progressive heart failure caused by cardiac amyloidosis with associated systemic involvement. This patient was not considered suitable for cardiac transplantation and active treatment was withdrawn. The third patient suffered a fatal in-hospital arrest five days after removal of the balloon.

Control of the arrhythmia was achieved in five patients, but because of severe ventricular impairment or dependence on mechanical support, cardiac transplantation was considered the optimal definitive management and these were continued on IABCP until they successfully underwent cardiac transplantation.

In total, 12 patients were eventually stabilised on medical treatment. Following stabilisation all patients underwent programmed ventricular stimulation. Ventricular tachycardia remained inducible in five patients, but in two the arrhythmia was haemodynamically unstable and these patients underwent implantation of a cardioverter-defibrillator.

IABCP failed to produce any improvement in the clinical situation in three patients and was subsequently discontinued. Amiodarone alone was effective in reducing the frequency of ventricular arrhythmia in two of these patients; however, haemodynamically unstable arrhythmia was still inducible during programmed stimulation and these patients therefore underwent implantation of a transvenous defibrillator. In the third patient, further haemodynamic deterioration necessitated the use of a left ventricular assist device before transplantation. IABCP was continued for a mean period of 5.1 days (range 1 to 10 days).

Nineteen patients were discharged from hospital and were followed as outpatients. During a mean follow-up period of 25.7 months the overall survival was 95%. There have been no late deaths from cardiac arrhythmia.

**Discussion**

Our experience shows that, in selected patients, the use of intra-aortic balloon counterpulsation can contribute to the management of medically refractory ventricular arrhythmia. That there were no complications related to the percutaneous insertion of the balloon catheter shows that this treatment can be used with a relatively high degree of safety in such patients. Our experience is supported by a larger survey that describes a complication rate of 4.6% in a series of 231 patients.

We believe that the use of mechanical support is of potential benefit in two groups of patients. The first group is those with severely impaired ventricular function in whom the development of ventricular arrhythmia suggests end stage cardiac failure. These patients tolerate negative inotropic agents poorly and will ultimately require cardiac transplantation as definitive treatment.

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**Table 3** Results of treatment with intra-aortic balloon counterpulsation (IABCP)

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<tr>
<th>Patient</th>
<th>Episodes of sustained ventricular tachycardia</th>
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<th>During IABCP</th>
<th>After IABCP</th>
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Fotopoulos, Mason, Walker, et al
supraregional transplant centre we have been able to provide such treatment, which undoubtedly contributes to the overall success of this approach.

The second group is those in whom either the arrhythmia itself or the administration of antiarrhythmic drugs has compromised a normally stable haemodynamic state. It is of interest that although the haemodynamic support provided was only temporary, it was sufficient to provide a therapeutic window for the stabilisation and subsequent discharge of patients on medical treatment alone (usually amiodarone). It is possible, therefore, that use of IABCP simply allowed time for effective antiarrhythmic treatment to work, or to allow washout of proarhythmic drugs.

Patients with incessant ventricular tachycardia are usually considered candidates for radiofrequency ablation, although this does have associated risk. In the 10 patients with IMVT in this series, eight had achieved control with IABCP, remaining stable after IABCP cessation. In this mechanism of action. It is clear, however, that in a significant number of patients this form of treatment is of use in aiding control of malignant ventricular arrhythmia when conventional treatment has failed or is slow to be effective. We believe therefore that IABCP should be considered in patients with refractory ventricular arrhythmia and impaired ventricular function.

STUDY LIMITATIONS

This was a retrospective review of our clinical practice and consequently detailed haemodynamic and electrophysiological data are not complete. Prospective analysis would be required to provide this information. As a result, it is difficult to explain why the arrhythmia remained suppressed after cessation of IABCP in some patients while it was ineffective at any stage in others. Furthermore, it is not possible to make any definitive comments about the likely mechanism of action. It is of note, however, that in a significant number of patients this form of treatment is of use in aiding control of malignant ventricular arrhythmia when conventional treatment has failed or is slow to be effective. We believe therefore that IABCP should be considered in patients with refractory ventricular arrhythmia and impaired ventricular function.
IMAGES IN CARDIOLOGY

Candida endocarditis of the right heart

An 84 year old woman was referred for surgical evaluation. Her clinical history was characterised by hypertension and a permanent pacemaker implanted in June 1997 because of complete atrioventricular block. Two months before, she had undergone successful antibiotic treatment for a gastrointestinal infection; one month after discharge she had septic fever and a new diastolic murmur. Blood cultures were positive for Candida albicans.

Transthoracic echocardiography showed normal cardiac sections and a large mass in the right atrium prolapsing into the tricuspid valve orifice. Transeosophageal echocardiography (pictured) showed two large vegetations: one attached to the pacemaker catheter; the second free in the right atrium and connected to the first vegetation. Both vegetations prolapsed into the tricuspid valve during dias-
tole. There were no signs of pulmonary involvement. The patient did not undergo surgery because her general clinical condition was very compromised and the surgical risk too high.

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Heart 1999 82: 96-100
doi: 10.1136/hrt.82.1.96