Catheterization and Cardiovascular Diagnosis 7:425–432 (1981)

Percutaneous Left Ventricular Angiography

C.M. Wong, MB, MRCP, P.H.C. Wong, MB, MRCP, and G.A.H. Miller DM, FRCP

Recurrence of persistence of heart failure in patients after mitral and aortic valve replacement is a difficult diagnostic problem. Clinical evaluation and noninvasive tests cannot always distinguish poor left ventricular function from paraprosthetic leak or persistent pulmonary vascular disease. Full evaluation by cardiac catheterisation may then be necessary but is difficult because of the inaccessibility of the left ventricle. Under these circumstances, left ventriculography by direct transapical puncture is an alternative to crossing the prosthesis by a catheter and may be the only way of obtaining diagnostic information. We describe our experience of left ventriculography by percutaneous transapical passage of a flexible angiographic catheter (as distinct from a rigid angiographic needle) in 15 such patients (on 16 occasions). Non-fatal complications occurred in three patients. The information thus obtained allowed a clinical decision to be made and distinguished the inoperable from the operable group. Surgery was subsequently performed in seven patients with beneficial results.

Key words: cardiac catheterisation, prosthetic valves, transurgical insertion of catheter

INTRODUCTION

In patients with mitral and aortic mechanical prosthetic valves, neither of the two conventional approaches to the left ventricle — retrograde via the aortic valve or transeptal and antegrade through the mitral valve — is possible without the risk of temporary dislocation or immobilisation of the poppet or disc by the catheter. The resulting haemodynamic disturbance caused by the catheter traversing the prosthesis may make measurements unrepresentative of those under normal conditions. When left ventricular pressure measurement is all that is required, transapical thoracic puncture with a fine needle (gauge 21) is a well-established technique [1]. On occasion, however, left ventriculography is required to establish the diagnosis and, in particular, to assess left ventricular function and to demonstrate or exclude paraprosthetic mitral regurgitation. Transapical left ventriculography using a rigid needle is a well-known, if seldom-used, technique. A similar technique with a non-rigid catheter was described by Lurie et al in 1962 for use in children [2]. It is the purpose of this

From Brompton Hospital, London, and Grantham Hospital, Hong Kong.

Address reprint requests to Dr. G.A.H. Miller, Cardiac Department, Brompton Hospital, London, SW3, England.

Received March 19, 1981; revision accepted June 3, 1981.

communication to report our experience of transapical left ventriculography with a non-rigid catheter in adults in whom entry to the left ventricle was otherwise impossible, usually because of the presence of mitral and aortic prosthetic valves. We have used the technique on 16 occasions in 15 patients without fatal complications. Though seldom required, the technique appears to be a safe and useful addition to those currently available in the catheterisation laboratory.

PATIENTS AND METHODS

Between 1968 and 1980, 15 patients (13 at the Brompton Hospital and two at the Grantham Hospital, Hong Kong), ages 23 to 71 years, underwent percutaneous left ventricular angiography with a conventional catheter (Table I). Ten patients had double prosthetic valve replacement (mitral and aortic) for rheumatic heart disease. Three patients had single aortic prosthetic valve replacement, one patient had calcific aortic valvular disease and ruptured chordae tendineae of the mitral valve, and one patient had congenital aortic stenosis and coarctation, patent ductus arteriosis, and aneurysm of the right coronary artery. The last two patients were investigated in Hong Kong. All patients, except the last had congestive heart failure. Three were in sinus rhythm and 12 in atrial fibrillation. In patients with previous valve replacement, clinical examination revealed signs of heart failure, and in the majority of patients a systolic murmur was audible. In all patients with previous valve replacement, clinical assessment failed to distinguish poor left ventricular function from paraprosthetic leak or from progressive pulmonary vascular disease as the cause of heart failure. In the patient with aortic and mitral valve disease, clinical examination failed to determine the relative severity of each lesion. Chest x-ray films showed cardiomegaly in all patients. Echocardiograms were available for nine patients. The findings are detailed in Tables I and II.

CATHETERISATION TECHNIQUES

Patients received either no medication of diazepam 10 mg orally 30 minutes before cardiac catheterisation depending on their clinical state. When measurement of the pressure gradient across the mitral or aortic valve was required, the pulmonary artery "wedge" pressure was obtained with a Goodale-Lubin or Swan-Ganz catheter via the right antecubital or brachial vein, and aortic pressure was obtained with a "pigtail" catheter via the right brachial or femoral artery.

Technical Details of Left Ventricular Angiography

1) The position of the cardiac apex is located by palpation and a radiopaque instrument, for example, forcep or scapel, is placed against the apical impulse on the chest wall so that the position may be checked by fluoroscopy and modified if necessary.

2) Following infiltration of the skin with 1% Lignocaine, the subcutaneous tissue and pericardium are anaesthetised until the infiltrating needle is felt to impinge on the cardiac apex, a moment frequently signalled by the appearance of one or more ventricular ectopic beats.

3) A small (2 mm) skin incision is made and a needle of 18-gauge internal bore, large enough to accept a 0.035 cm diameter guidewire, is advanced towards the back of the

TABLE I. Clinical Details of Patients

Case number	Age, Sex	Previous surgery	Prosthesis used	Months postop	Presentation	Cardiac murmurs present
1	39M	MVR AVR	SE SE	9	CCF	SM
2	32M	MVR AVR	SE SE	6	CCF	DM
3	56M	MVR AVR	SE SE	8	CCF	SM
4	70M	MVR AVR	SE SE	24	CCF	None
5	59M	MVR AVR	SE SE	26	CCF	SM
6	42M	AVR	BS	13	CCF	SM DM
7	44F	MVR AVR	Beall SE	8 yr	CCF	SM
8	64F	MVR AVR	BS BS	4	CCF	SM EDM
9	59M	AVR CABG	SE	15	CCF	SM
10	31M	MVR AVR Repair of dehiscent MVR	BS BS BS	34 1	CCF No improvement after repair	SM SM
11	53M	MVR AVR	BS BS	12	CCF	SM EDM
12	48M	AVR	SE	10	CCF	SM
13	54M	MVR AVR	SE SE	4 yr	CCF	SM
14	62F	–	–	–	CCF	SM
15	23M	–	–	–	Asymptomatic	Continuous

AVR, aortic valve replacement; MVR, mitral valve replacement; SE, Starr-Edwards; BS, Bjork Shiley; CCF, congestive cardiac failure; SM, systolic murmur; DM, diastolic murmur; EDM, early diastolic murmur, CABG, coronary artery bypass graft.

TABLE II. Correlation of Echocardiographic, Catheter, and Operative Findings

Case number	Echocardiogram	Catheter findings	Complications	Operative findings	Remarks
1	N.A.	Gross MPL	Haemothorax requiring drainage	Gross MPL	MVR
2	Poor LV function	Poor LV function	None	–	Antifailure treatment
3	N.A.	Gross MPL	None	Dehiscent mitral prosthesis	MVR. Died of respiratory failure
4	N.A.	Poor LV function	None	–	Antifailure treatment
5	N.A.	Poor LV function	Transient hypotension	–	Antifailure treatment
6	N.A.	Mild MR, mild APL	None	–	Antifailure treatment
7	PL	Gross MPL	None	Worn disc mitral prosthesis	MVR
8	PL	Gross MPL, mild APL	Transient hypotension	Mitral prosthesis dehiscence	MVR
9	Poor LV function	Poor LV function Mild MR	None	–	Antifailure treatment
10	N.A.	Mild APL, gross MPL	None No improvement following repair	Mitral prosthesis dehiscence	Repair of mitral prosthesis
	Gross MPL	Gross MPL	None	MPL	MVR
11	Poor LV function	Poor LV function	None	–	Antifailure treatment
12	N.A.	Poor LV function Mild APS	None	–	Antifailure treatment
13	Poor LV function	Poor LV function	None	–	Antifailure treatment
14	Rheumatic MR. Aortic stenosis	Gross MR Aortic stenosis	None	Ruptured chordae Calcific aortic valve	MVR, AVR
15	Normal cardiac anatomy	PDA Preductal coarctation Aortic stenosis	None	Coarctation of aorta. PDA, aortic stenosis	Surgical correction of PDA and coarctation

LV, left ventricle; PL, paraprosthetic leak; MPL, mitral paraprosthetic leak; APL, aortic paraprosthetic leak; MR, mitral regurgitation; PDA, patent ductus arteriosis; MVR, mitral valve replacement; AVR. aortic valve replacement; APS, aortic prosthetic stenosis; N.A., not available.

right shoulder until it enters the left ventricular cavity. The needle is connected to a pressure transducer by a length of flexible manometer tubing so that the moment of entry into the ventricle will be signalled by the appearance of a ventricular pressure trace on the oscilloscopic display. Care is taken to ensure that the pressure trace is undamped, with a clear display of early and end-diastolic pressure. In case of difficulty, the position of the needle is checked fluoroscopically. Occasionally, the right ventricle is entered. This error can be recognised by the lower systolic pressure of the ventricular trace as compared to that of the ascending aorta. The needle should then be withdrawn and reintroduced more posteriorly.

4) With the needle in the left ventricular cavity, the manometer tubing is disconnected, and a guidewire is advanced under fluoroscopy until three to four inches of the guidewire is lying within the cavity of the left ventricle.

5) A Teflon Gensini angiographic catheter, French size 6, 7 or 8, is then advanced over the guidewire, and its position is checked fluoroscopically. The catheter is then used for angiography. Ideally the catheter should be as short as possible to permit a rapid delivery of contrast medium. Teflon Gensini angiographic catheters of French size 6, 7 or 7.5 and only 65 cm long have been made available to us by USCI.

The above described technique is nothing more than a combination of standard transapical puncture and standard percutaneous insertion of a catheter over a guidewire. Certain details are worth emphasizing, however.

1) Oral anticoagulant therapy should be adjusted to give a prothrombin ratio within the therapeutic range to reduce the risk of bleeding complications.

2) The use of fluoroscopy to check the position of the apex and the position of the needle, guidewire, and catheter is a valuable aid. The true apex is frequently one intercostal space lower than that located by palpation.

3) The needle should be advanced under pressure monitoring.

4) All preparations for angiography, pressure recording, etc should be completed before the puncture is begun.

MEASUREMENTS

Simultaneous pulmonary artery wedge pressure, aortic pressure, and left ventricular pressure were recorded with a fluid-filled system connected to a pressure transducer. Cardiac output was determined by the Fick principle. Angiography was performed after haemodynamic measurements had been made.

RESULTS

The angiographic catheter was introduced in all 15 patients on 16 occasions without difficulty, and diagnostic left ventricular angiograms were obtained in all. In two instances, the exploring needle entered the right ventricle. The needle was then withdrawn and reintroduced into the left ventricle without sequelae. The gradient across the mitral or aortic valve was measured in all patients when this information was required. In the patient with congenital aortic stenosis and preductal coarctation, ascending aortic pressure was not obtainable by retrograde passage of a catheter due to aberrant subclavian vessels and failure to cross the coarctation from the femoral ap-

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.