Cardiac Perforation Following Left Ventricular Cineangiocardiography

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Since selective cineangiocardiography has become an integral part of cardiac catheterization, one of the dreaded complications has been that of cardiac perforation associated with the rapid injection of contrast media under high intracatheter pressures. It is the purpose of this communication to report a case of left ventricular perforation during cineangiocardiography in a patient with aortic stenosis. This case is of interest because of (1) the record obtained by cineangiocardiography of the acute development of cardiac tamponade (2) the successful management of the complication, and (3) no evidence of pericardial abnormality 5 days after the event.

Case Report

K. L., a 27-month-old male infant was admitted to Duke Hospital because of shortness of breath with exertion. Physical examination revealed a grade-IV harsh, prolonged ejection systolic murmur maximum over the second right intercostal space. The electrocardiogram indicated marked left ventricular hypertrophy. The chest x-ray showed mild cardiac enlargement.

Preoperative cardiac catheterization was performed under nitrous oxide general anesthesia. Right heart catheterization revealed normal right ventricular and pulmonary artery pressures. Radioisotope and peripheral arterial dye-dilution curves were normal. A number-6 NIH catheter was passed via the femoral artery to the aortic arch, where a biplane cineangiogram showed marked abnormality of the aortic valve with poststenotic dilatation of the ascending aorta. The catheter was passed across the aortic valve into the left ventricle with a pressure change from 80/60 mm. Hg in the aortic root to 180/0 mm. Hg in the left ventricle (calculated aortic valve area: 0.37 cm.²). It was noted that the curvature of the catheter tip was located laterally and somewhat posteriorly within the ventricle. Although the tip was moving with each beat, there was a snapping sensation associated with each attempt to withdraw the tip from this position into the midportion of the left ventricular cavity. Repeated attempts to move the catheter tip toward the apex of the left ventricle were unsuccessful. Finally, the catheter tip was left in place, positioned somewhat laterally and posteriorly (fig. 1a). In preparation for biplane cineangiocardiography, blood was aspirated from the catheter and two rapid hand injections of 8 ml. of saline were made with no arrhythmias or electrocardiographic changes noted. Subsequently, an Amplatz Injector with a gauge pressure of 125 lb./in.² (intracatheter pressure—625 lb./in.²) was used to inject 13 ml. of 75 per cent Hypaque. Coincident with injection, contrast medium surrounded the left ventricular area of the heart in addition to filling the left ventricular cavity. Figure 1b demonstrates the biplane cineangiogram obtained 2 seconds after injection.

The catheter was withdrawn immediately from the left ventricle into the descending thoracic aorta for continuous pressure monitoring. There was an immediate drop in aortic blood pressure from 80/60 to 50/30 mm. Hg. The electrocardiogram showed transient runs of premature ventricular beats followed by a constant normal sinus rhythm; however, there was elevation of the ST segment which disappeared within 3 minutes. Following the fall in blood pressure to shock levels, an intravenous infusion of 0.1 per cent neosynephrine solution in 5 per cent glucose water was started. Repeated observation of the heart under image intensification showed the development of cardiac tamponade within 5 minutes (fig. 2a). The movement of the heart was noted to be markedly diminished in systole with a marked early diastolic thrust. Direct anterior chest pericardial puncture was performed with removal of 65 ml. of blood-stained fluid. There was an immediate improvement in the patient's condition. The aortic pressure rose to 82/52 mm. Hg and biplane cineangiography (fig.
Cardiac perforation during left ventricular cineangiography. A, upper. Cine frames depicting catheter position prior to injection. The catheter tip was high and posterior, located between the posterior leaflet of the mitral valve and left ventricular free wall 1 second prior to the injection. B, lower. Cineangiogram demonstrating cardiac perforation. These pictures were obtained 2 seconds following injection of contrast media.

2b) demonstrated return of the heart size to its previous dimensions with vigorous activity. Thereafter, the patient’s condition remained stable. The catheters were removed, and the patient was transferred to the recovery room 45 minutes later. He awakened immediately following the termination of anesthesia and made an uneventful recovery. Repeated x-ray examinations showed no increase in heart size and after 12 hours there was no contrast medium discernible in the pericardial sac. The following day, he was up and playing about on the ward. His course was uneventful thereafter. Five days following cardiac catheterization, he underwent surgery for aortic valvotomy. At surgery, no fluid or abnormality of the pericardial sac was noted. The pericardial tissue was glistening and appeared healthy. However, there was a small 1-cm.² area of discoloration on the posterior lateral aspect of the free wall of the left ventricle near the atrioventricular groove. The patient made an uncomplicated recovery following surgery. Repeated follow-up examinations in the outpatient clinic have revealed the disappearance of his preoperative symptoms and reduction in the left ventricular hypertrophy noted on the electrocardiogram.

**Discussion**

The occurrence of ventricular perforation during selective cineangiography has been reported by several investigators. Most of these have been associated with the catheter positioned in the right ventricle¹-⁴ although left ventricular perforation also has been documented.⁵ In our patient, the occurrence of ventricular perforation was attributed to the abnormal position of the catheter. Prior to the injection,
there was easy withdrawal of blood from the catheter and two rapid injections of saline produced no arrhythmias. Review of the biplane cineangiogram revealed the tip of the catheter to be located beneath the posterior leaflet of the mitral valve (fig. 1a) and coincident with the injection, the catheter tip penetrated into the pericardial sac. It was considered that the catheter tip had become fixed between the valve cusp and the ventricular free wall. Although a non-stiff NIH catheter was utilized, it was considered that there was marked stiffening of the catheter associated with the power injection with resultant impalement of the catheter in this position and subsequent penetration through the ventricular wall.

The absence of pericardial reaction at cardiac surgery 5 days after left ventricular penetration was observed. This was also the experience of Pocock et al.6 following perforation of the pulmonary artery in a child with a patent ductus arteriosus subjected to surgery 3 weeks subsequent to hemorrhage into the pericardial sac.

During the past 2 years in our laboratory, 190 left ventricular cineangiograms have been performed with a power injector. Considerable difficulty was encountered with the use of the end-hole Lehman catheter with recoil of the catheter into the aortic arch associated with high pressure injections into the left ventricle in 25 patients. NIH catheters have been used in the remaining 165 cases without incident. With the use of Lehman catheters, there were three instances of subendocardial staining with contrast material. This has not been noted with the NIH catheter. A review was made of previous left ventricular injections with NIH catheters and in none was the catheter position found such as described in this patient. However, during retrograde left ventricular catheterization in four patients, we have noted the course of the catheter to be directed to a position beneath the posterior leaflet of the mitral valve immediately upon traversal of the aortic valve. Withdrawal of the catheter from this position produced a sudden “jerk” of the catheter as it became dislodged from this position. These experiences have impressed upon us the importance of viewing the catheter in the lateral view in addition to the usual AP projection, to ascertain that the catheter tip has not become impaled beneath the posterior leaflet of the mitral valve prior to selective left ventricular angiography.

In contrast to the expected recovery following perforation of the ventricle during selective angiography, penetration of the atrium is associated with a considerably higher mortality. Once perforation of the ventricle has occurred, the catheter may be withdrawn with close observation of the patient and repeated pericardiocentesis should tamponade develop. However, in the eventuality of atrial penetration, continued severe bleeding occurs. Lurie and Grago7 have indicated that the catheter should be left in situ for continued aspiration and prevention of bleeding until surgical intervention can be carried out for atrial perforations.

Summary

A case of perforation of the left ventricle during selective cineangiography in a 27-month-old child with aortic stenosis is reported. Perforation was visualized during the power injection, and subsequent cardiac tamponade developed. Immediate pericardiocentesis resulted in rapid improvement and the child made an uneventful recovery. At cardiac surgery for aortic valvotomy 5 days later no abnormalities of the pericardium were noted but there was a small area of discoloration on the posterior left ventricular free wall. Prevention of poor catheter positioning is suggested as the major preventive measure to avoid such complications during selective ventricular angiography.

References


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Andreas Vesalius

And equally inevitably this deplorable dismemberment of the art of healing has introduced into our schools the detestable procedure now in vogue, that one man should carry out the dissection of the human body, and another give the description of the parts. These latter are perched up aloft in a pulpit like jackdaws, and with a notable air of disdain they drone out information about facts they have never approached at first hand, but which they merely commit to memory from the books of others, or of which they have descriptions before their eyes; the former are so ignorant of languages that they are unable to explain their dissections to the onlookers and botch what ought to be exhibited in accordance with the instruction of the physician, who never applies his hand to the dissection, and contemptuously steers the ship out of the manual, as the saying goes. Thus everything is wrongly taught, days are wasted in absurd questions, and in the confusion less is offered to the onlooker than a butcher in his stall could teach a doctor.—The Preface of Andreas Vesalius to "De fabrica corporis humani 1543." Translated by B. Farrington. (Cape Town). Proc. Roy. Soc. Med. 25: 1357-1366, 1932. (Submitted by Howard B. Burchell, M.D.)
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Circulation. 1965;32:593-596
doi: 10.1161/01.CIR.32.4.593

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