A Modified Approach to Percutaneous Insertion of the Intra-Aortic Balloon

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Abstract

The perarterial intra-aortic balloon (PAIAB) insertion technique has been shown at our institution to significantly reduce ischemic complications common to intra-aortic balloon (IAB) use. This technique is a modification of the percutaneous insertion method and utilizes the same introducer system. The common femoral artery is exposed and the balloon inserted under direct visualization.

Forty-five consecutive patients underwent attempted (PAIAB) insertion. Successful passage on the first attempt was accomplished in 39 patients (87%) and in 42 patients (93%) when the contralateral femoral artery was employed. In three patients (7%), the balloon could not be passed via either femoral artery. In 36 patients, the balloons were inserted preoperatively for support of high risk left main or left main equivalent coronary artery disease or poor left ventricular function prior to anesthetic induction. Twenty-nine intra-aortic balloons were removed immediately post perfusion with no incidence of thrombus on the balloon or catheter. Thrombus was present on four of 13 intra-aortic balloons (31%) left in from one to seven days.

Balloon removal was accomplished in the operating room under direct vision which allows for assessment of the puncture site, thrombus removal, and arterial repair. Had the artery not been exposed, the four patients with thrombus present could have suffered limb ischemia.

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Introduction

A technique for intra-aortic balloon (IAB) insertion has been developed, refined, and employed successfully in over forty patients without complication. The technique utilizes the recently developed percutaneous IAB catheter and introducer system. In lieu of inserting and removing the balloon catheter in a blind percutaneous manner, the femoral artery is surgically exposed. Utilizing the percutaneous introducer system, the method described herein is employed: perarterial intra-aortic balloon insertion (PAIAB).[1]

Background

Use of IAB therapy has gained widespread acceptance for the treatment of medical and surgical patients with left ventricular power failure.[2] It has proven to be the most effective mechanical afterload reduction method currently available. In addition, it can significantly increase coronary artery perfusion pressure during diastole.[3]

Until recently, introduction of the IAB required surgical anastomosis of a dacron side-arm graft to the femoral artery—a lengthy procedure for both insertion and removal.

The percutaneous IAB system was developed to facilitate insertion and removal of the balloon

catheter and to spare the patient a surgical procedure.[4,5] There are, however, significant complications associated with this method.

PAIAB insertion was developed to provide for a more rapid balloon insertion than the conventional side-arm method and with fewer complications than the percutaneous method.

Method

The perarterial technique can be performed in the intensive care unit or in the operating room. The IAB can be inserted with the patient awake utilizing a local anesthetic.

Following prepping and draping of the groin area, approximately 15cc of 1% lidocaine is injected. The common femoral artery is isolated and vessel loops placed proximal and distal to the planned insertion site. The patient is heparinized systemically with 100 U/kg of heparin.

The percutaneous IAB[a] is wrapped and moistened according to the manufacturer's instructions.[6]

The artery is examined for plaque. When a suitable insertion site is determined, the initial arterial puncture is accomplished with an 18G angiographic needle. (Fig. 1) A J-tipped guide wire is inserted through the needle into the abdominal aorta and the needle removed over the guide wire. An 8Fr. teflon dilator is advanced over the guide wire to dilate the puncture site. (Fig. 2) The 8Fr. dilator is removed. A combination 12Fr. dilator and introducer sheath is passed over the guide wire (Fig. 3) and maximally inserted. The guide wire and dilator are removed leaving the 12F sheath in the artery.

The length of balloon catheter to be inserted is estimated by measuring from the suprasternal notch to the distal end of the introducer along the course of the aorta. A suture is tied on the catheter as a marker. The IAB is inserted through the sheath into the descending aorta. (Fig. 4) If resistance is encountered during advancement, the catheter is rotated but no additional force is applied. When in position, the vacuum applied to the balloon is released and the catheter connected to

[a] PERCOR® IAB, Datascope Corp., Paramus, NJ 07652

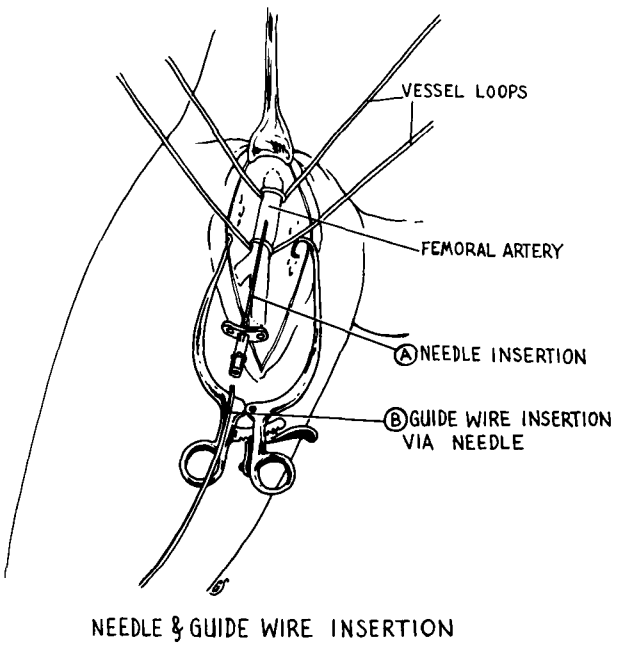

FIGURE 1. Common femoral artery exposed. Arterial puncture accomplished with 18G angiographic needle. Guide wire ready for insertion through needle.

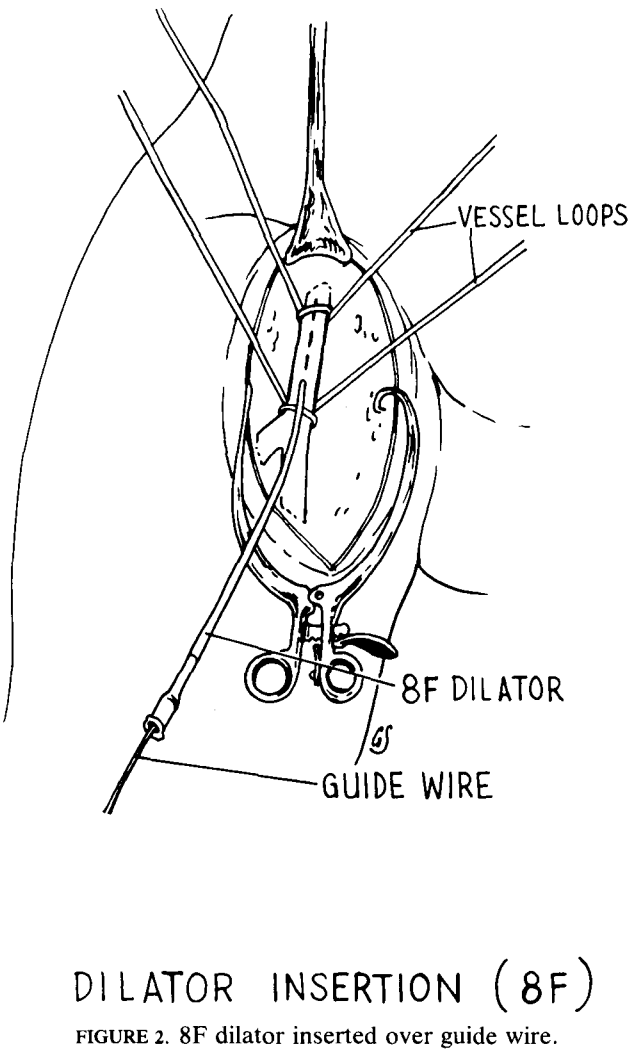

FIGURE 2. 8F dilator inserted over guide wire.

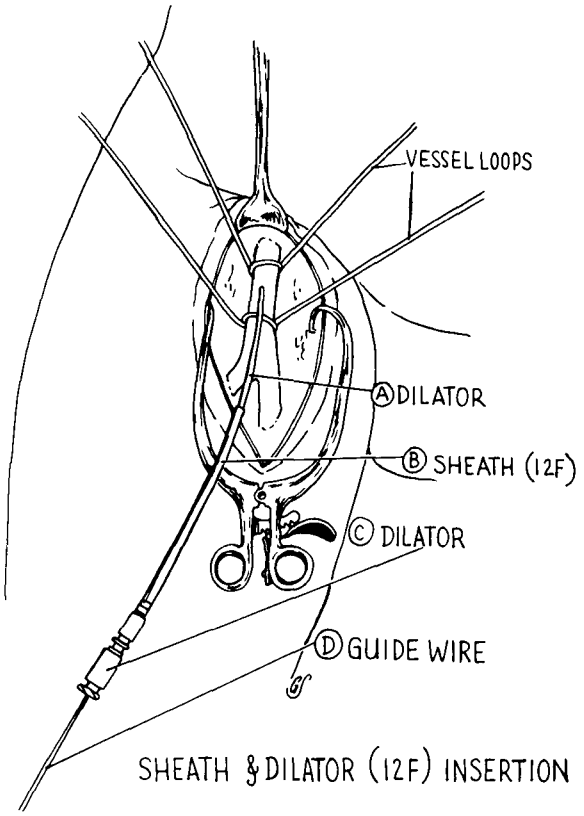

FIGURE 3. 12F dilator and catheter introducer in place. Guide wire is withdrawn followed by 12F dilator.

the IAB pump console. Balloon pumping is initiated. The safety chamber balloon at the pump console and the arterial pressure wave form are examined to verify balloon unwrapping. A damped pressure wave and incomplete compression of the safety chamber balloon indicate failure of the balloon to unwrap. The catheter is then rotated to achieve unwrapping. The arterial pressure wave obtained from the left radial artery aids in balloon positioning. If the IAB catheter is advanced too far, the arterial wave form will be dampened if the arterial line is placed in the last radial or brachial artery.

Once the desired augmentation is achieved, the sheath is secured to the balloon catheter with a ligature to prevent back bleeding. The catheter is secondarily secured to the skin inferior to the incision. The subcutaneous tissue is closed over the catheter and sheath, and the skin is closed. Heparin (1000 U/hr) and prophylactic antibiotics (Cefazolin) are used for the duration of IAB therapy.

The extremities are examined frequently during balloon operation and ankle Doppler pressures are obtained every four hours.

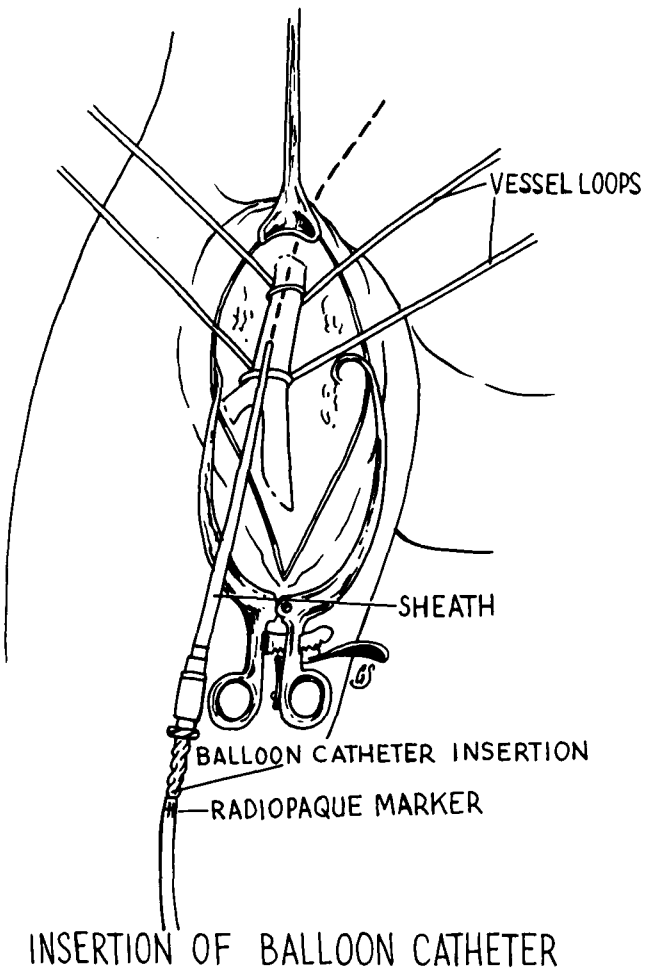

FIGURE 4. Wrapped and evacuated percutaneous-type IAB inserted through the introducer sheath into the descending aorta.

At our institution, all intra-aortic balloons are removed in the operating room under local anesthesia. This can also be accomplished in the ICU. However, we feel the risk of insertion site sepsis or septicemia is minimized if insertion and removal of the balloons occur in the operating room.

The incision is re-opened and vessel loops are placed around the common femoral artery proximal and distal to the insertion site. The introducer sheath and balloon are withdrawn and examined for thrombus. If thrombus is present, the artery can be thrombectomized proximally and distally through the insertion site. The insertion site is then examined and the 2–3 mm rent in the artery is repaired with a 6-0 polypropylene suture. The wound is irrigated with an antibiotic containing solution and closed. Total removal time is 15–20 minutes, no longer than the recommended time

required to maintain pressure following percutaneous withdrawal.

Results

The PAIAB insertion technique was attempted in 45 patients and successful in 39 (87%) cases on a single passage. Use of the opposite femoral artery was necessary in three cases and in three cases the balloon could not be inserted into either femoral artery.

Intra-aortic balloons were inserted in 36 of these patients pre-operatively to give mechanical support prior to induction of anesthesia for the following high-risk categories: 1) left main or left main equivalent coronary artery disease, 2) unstable angina, and 3) poor left ventricular function. None of these patients exhibited evidence of perioperative infarction. In six patients, the PAIAB was inserted post-cardiopulmonary bypass for post-cardiac surgery low output. Twenty-nine of the balloons inserted prior to anesthetic induction were removed after termination of cardiopulmonary bypass. In the remaining 13 patients, the balloon was left in from one to seven days. In four of these 13 patients (31%) thrombus was present on the balloon or catheter when removed. This occurred despite the fact that all patients were receiving a heparin infusion while the balloon was functioning. At no time was the balloon left nonfunctional. In these patients the artery was thrombectomized.

In two of 42 (5%) patients, the balloon required manipulation consisting of rotation and re-inflation to accomplish augmentation because of failure of the balloon to unwrap. Despite manipulation, one balloon (2.5%) failed to unwrap requiring insertion of a second balloon.

All patients were evaluated for evidence of complications and limb ischemia. No patients demonstrated reduction in ankle Doppler pressures either during balloon functioning or when compared to pressures obtained prior to balloon insertion. In addition, there was no evidence of limb ischemia, bleeding at the puncture site, aortic dissection, pseudoaneurysm at the insertion site, or bacteremia. Patients have been followed from two to 22 months.

Discussion

The perarterial technique (PAIAB), with insertion and removal of the IAB through an exposed femoral artery is an advantage over both the side-arm graft and the percutaneous insertion methods. At the time of insertion, the puncture site can be carefully selected, thereby avoiding insertion through a plaque or insertion into the superficial femoral artery rather than the common femoral artery. A reduced angle of insertion can be employed fascilitating passage of the dilator and sheath system. This is especially helpful in obese patients.

Complications resulting from percutaneous IAB insertion are beginning to appear in the literature.[7] When the size of the defect in the femoral artery made by the 12F catheter is assessed, it is not surprising that such complications as groin hematoma or false aneurysm occur. At the time of removal, exposure of the femoral artery allows for visualization of any thrombus removed with the balloon. With the percutaneous method, any thrombus adherent to the balloon will remain in the artery. With the PAIAB method, the artery can be thrombectomized if necessary.

The PAIAB method results in a more rapid insertion than the side-arm graft technique and takes only minutes longer than percutaneous insertion, with fewer complications.

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