Minimally Invasive Midaxillary Muscle Sparing Thoracotomy for Atrial Septal Defect Closure in Prepubescent Patients

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Background. **Partial sternotomy, as well as posterolateral or anterolateral right-sided thoracotomy, are used for correction of selected cardiac lesions in children. However, in female patients impaired breast development after an anterolateral thoracotomy is reported, and for both the posterolateral and the anterolateral approach, partial transection of large muscle groups is required. The midaxillary approach may help to avoid these side effects and improve the cosmetic result.**

Methods. **Beginning in April 2003, our institutional policy changed toward a midaxillary approach in prepubescent patients with an atrial septal defect, in whom criteria for catheter closure were not fulfilled. Thoracotomy was performed after a horizontal midaxillary incision and mobilization of the latissimus dorsi and splitting of the serratus anterior. Aorta and caval veins were cannulated directly. The atrial septal defect was closed during electrically induced fibrillation of the heart.**

Results. **Until August 2004, this technique was applied in 36 patients (30 girls, 6 boys), with no need for conversions to another approach. Mean patient age was 6.9 ± 2.6 years (range, 4 to 14 years), with a mean weight of 23.8 ± 11.2 kg (range, 15 to 69 kg). Skin incision ranged from 4.5 to 6.0 cm. Mean cardiopulmonary bypass time was 31 ± 13 minutes (range, 13 to 73 minutes), with a mean ventricular fibrillation time of 21.2 ± 7.4 minutes (range, 10 to 42 minutes). In 28 of 36 patients a patch was used. No phrenic nerve damage occurred.**

Conclusions. **The midaxillary approach is a safe alternative to lateral thoracotomies frequently used in cardiac surgery for atrial septal defect closure. It helps to improve the cosmetic result in the prepubescent patient group. We believe that its application should not be expanded to include repair of more complex lesions or to patients below the age of 3 to 4 years. For these, variations of cosmetically favorable partial sternotomy techniques should be applied.**

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Secundum atrial septal defect accounts for 6% to 10% of congenital heart disease at birth and is the most common congenital heart defect in adulthood [1]. The first successful atrial septal defect closure was performed through an anterolateral thoracotomy by F J Lewis in 1952 [2]. Over the years, the operative mortality and morbidity decreased dramatically [3, 4].

Today, the catheter-based closure devices have become accepted alternatives to surgery in selected cases [5, 6]. However, limitations for the interventional closure are defect size, insufficient rim, and complex anatomy. New minimally invasive approaches, such as ministernotomy [7–9], transxiphoid approach without sternotomy [10, 11], anterolateral thoracotomy [12], and posterolateral thoracotomy [13, 14] have gained in popularity. Most recently, Yang and colleagues [15] and our group [16] have described initial results using a midaxillary approach.

Prebubescent patients represent a special group in regard to surgical treatment. Our long-term follow-up in prepubescent female patients after right anterolateral thoracotomy revealed significantly impaired unilateral breast development [17]. Based on these findings, we abandoned our routine anterolateral approach in this subgroup of patients. In the present report, our surgical experience in 36 consecutive patients with the minimally invasive midaxillary muscle-sparing thoracotomy is described, and the current literature regarding other surgical approaches is reviewed.

Patients and Methods

Patients

Between April 2003 and August 2004 our institutional policy changed toward a midaxillary approach in prepubescent patients with an atrial septal defect, in whom criteria for catheter closure were not fulfilled. Of the 36

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Fig 1. The skin is incised and the subcutaneous tissue dissected right down to the latissimus dorsi muscle with the midaxillary incision line beginning at the height of the mammary areola and passing posteriorly toward the tip of the scapula.

patients, 30 were girls and 6 were boys. Mean patient age was 6.9 ± 2.6 years (range, 4 to 14 years), with a mean weight of 23.8 ± 11.2 kg (range, 15 to 69 kg). Operative notes and discharge summaries were reviewed to ascertain patient characteristics and surgical outcome. All patients had intraoperative transesophageal echocardiography routinely performed, and another transthoracic echocardiography before discharge.

Surgical Technique

The patient is placed in an oblique position at an angle of 90 degrees, with the arm suspended at a right angle. The skin incision is performed in the midaxillary line. Beginning at the height of the mammary areola, it passes posteriorly toward the tip of the scapula. The subcutaneous attachments of the latissimus dorsi muscle are mobilized with electrocautery by dissecting just superficially to the fascia. The entire anterior border of the muscle is freed (Fig 1). The muscle can then be retracted posteriorly, exposing the serratus anterior muscle. This muscle is split in a longitude manner and the thorax opened in the bed of the fourth rib. The heart is exposed adequately by opening the pericardium, avoiding incision near the phrenic nerve. Suitable stay sutures are placed, and the pericardium retracted through the thoracal cavity to the skin. Tapes are passed around the caval veins. Two standard purse-string sutures are placed on the ascending aorta, and direct cannulation is performed. After placing two more standard purse-string sutures at the junctions of the caval veins with the right atrium, bicaval cannulation is performed (Fig 2). Cardiopulmonary bypass is instituted under normothermia. The operating table is then tilted, keeping down the head of the patient. The caval venous tapes are snared, fibrillation is induced electrically, and the right atrium is opened. A vertical incision in the midportion of the atrium is performed. In our experience, this facilitated access in contrast to the standard oblique atrial incision. Two pump suckers, of

Fig 2. The thorax is opened, suitable stay sutures are placed, and the pericardium retracted through the thoracal cavity to the skin. Direct cannulation of the aorta and of the superior caval vein is performed. The inferior caval vein is cannulated through the right atrium.

which one is placed in the coronary sinus, allow clear exposure of the right atrial cavity. The intraatrial defect is either closed with direct suture or patch material. The pericardial stay-sutures are then removed before gradually inflating the lungs for removal of air. Simultaneously, blood is withdrawn with a needle and a syringe from the left atrium and the aorta. Then, the heart is defibrillated. After a short period of reperfusion, the patient is weaned from bypass. For closure, pericostal sutures are placed, and the muscles are allowed to return to their normal position.

Results

Skin incision ranged from 4.5 to 6.0 cm. No patient operated upon with the limited access required conversion to a larger skin incision. Femoral or iliac cannulation was not used in any patient. Mean cardiopulmonary